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ORIGINAL ARTICLES

PROBABLE PRIMARY FACTORS CONTROLLING OCCLUSION. RADIOGRAPHIC FINDINGS*

BY GEORGE P. PHILLIPS, A.B., D.M.D., BOSTON, MASS.

THE subject of occlusion, balanced occlusion and the factors controlling the same, has been the center of innumerable discussions and the cause for the development, from time to time, of various theories, intended to explain their causative factors which are still more or less obscure.

The prosthodontist, by virtue of his specialty, is more interested in the conditions which he actually finds in his patients as they present themselves for treatment, with a view of constructing workable substitutes, than in the knowing of the various primary factors controlling the development of occlusion in a full natural denture.

In the construction of prosthetic appliances the matter of the utmost importance is the accurate diagnosis of the condition to which a patient's masticatory apparatus has been reduced through years of use, or lack of use, so that the construction of substitutes can be consistently carried through.

The orthodontist, however, has a different problem. He has no substitutes to construct. His aim is to correct an ill-functioning occlusion with its train of ills. That is, to ameliorate conditions where the evil has progressed too far for complete correction, and do better in the cases which come to his attention at their incipiency.

His problem, therefore, assumes the magnitude of no mean proportions.

It has been pointed out to us by many, and we have every reason to believe it to be so, that an appreciable proportion of cases of malocclusions and marked asymmetries in the arrangement of the teeth and development

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of the bones of the jaws and the head, originate not after birth or the eruption of the teeth, but long before the child is born, and perhaps with the parents.

Being a prosthodontist, and having come into close contact with a num-

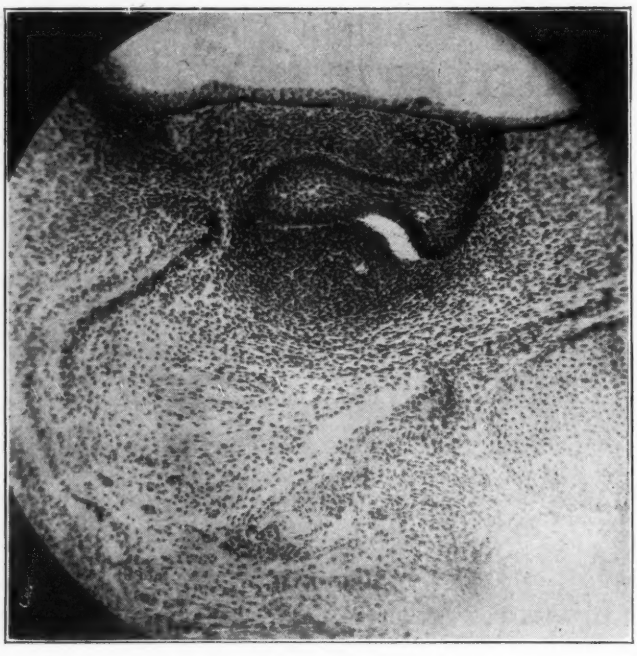


Fig. 1-*A*.

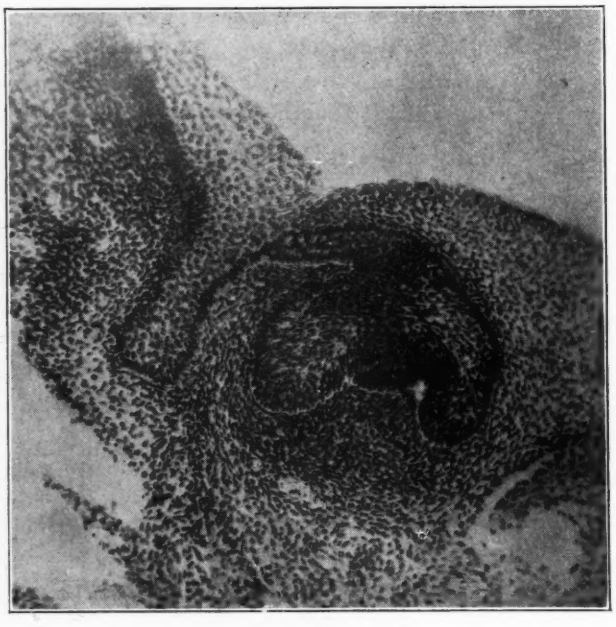


Fig. 1-*B*.

ber of patients who have gone through prolonged periods of orthodontic treatment at some time or other, and with results varying from a moderate improvement to decided failures, I have become more or less interested in the

Fig. 1-*C*.

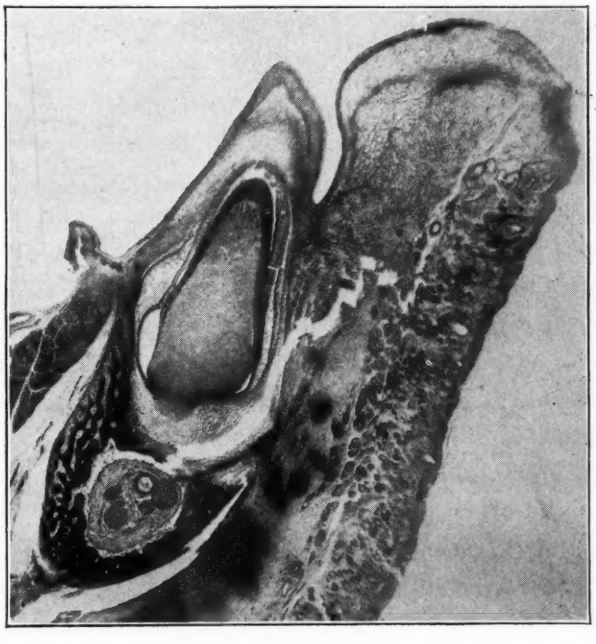


Fig. 1-*D*.

orthodontic problem from the standpoint of the probable causes of malocclusion, and also the causes for the frequent failures in cases which eventually find their way into the offices of the general practitioner or prosthodontist for restorative work, I feel sure, however, that if some of the patients to whom I am referring could have had the present advanced and more scientific type of orthodontic work performed on their teeth, the percentage of those needing prosthetic attention would have been much smaller.

Without being too technical, I will first say a word about heredity and will then try to briefly cover the embryology and development of the jaws and the teeth, because I feel that by having a common understanding of the course of the vital processes in operation during embryonic development you will be enabled to follow my line of thought more easily.

HEREDITY

Of heredity, and by it I refer to the transmutation of type only, we know so little, that I will not attempt to say anything, other than to point to certain striking characteristics of the enamel of the teeth, in which heredity, I think, plays an important part.

It is a known fact that the type and character of a tooth is ascertained by its visible part, which is the crown or the enamel covering of the tooth. The enamel of a tooth, as we are all aware, is of a purely ectodermal origin. One of its features or characteristics is that it stands apart from the other surrounding tissues of the mouth, and also, to a great extent, from the underlying dentine.

It is the only adult tissue that retains its characteristic individuality throughout its development and life, apart from all other structures which are derived from either the endoderm or the mesoderm or both, and which, after full development and calcification, stops growing or regenerating.

Consequently the enamel being the direct product of the ectoderm, that is, the outer layer of the three germ layers in the development of an embryo, by virtue of retaining its pure ectodermal characteristics apart from any of the other structures which are of different origin, and also being unlike all other structures in not regenerating either during or after full development, *becomes a structure more likely* to retain its pure characteristics of type peculiar to one or the other parent, than any other structure of the human body.

This may be an assumption, and it is lacking, as it were, the support of a law of heredity as yet to be discovered, but is thoroughly supported by clinical evidence. Thus we find innumerable cases where the children in a family, either one or all, have inherited the tooth type from one parent, and the feature type from the other parent.

So strikingly did this come to my notice six years ago in a family of five, where the father was an Englishman of the true Anglo-Saxon type and the mother an American of pure French descent, that I have endeavored to make a mental note of all other similar cases, and in every case I found the same strikingly similarity of occurrence. All of the children in this case had the father's long, tapering teeth and the mother's small, delicate features, with the exception of the boy who had inherited both the father's features and teeth. In the case of the other two children, both girls, Nature was trying to accommodate large teeth in small arches with the result that both daughters were under the care of an orthodontist, to the thorough disgust of the father, who felt that his daughters were losing their sweetness and individuality as their "mouths were being stretched and made larger."

DEVELOPMENT OF THE TEETH AND THE DENTAL ARCHES

Coming to the development of the teeth and the dental arches, a brief review of their embryology will give us a picture worth keeping in mind.

"The first indication of tooth development in human embryos is a thickening of the oral epithelium, which has been observed in specimens measuring 11 to 12 mm." "Soon after the thickening has appeared, it grows upward in the upper jaw, and downward in the lower jaw, into the adjacent mesenchyma, thus forming an epithelial plate which follows the circumference of either jaw. It undergoes the same sort of transformation in both the maxilla and the mandible, and following the description of the conditions in the mandible is therefore applicable to both. As the plate descends into

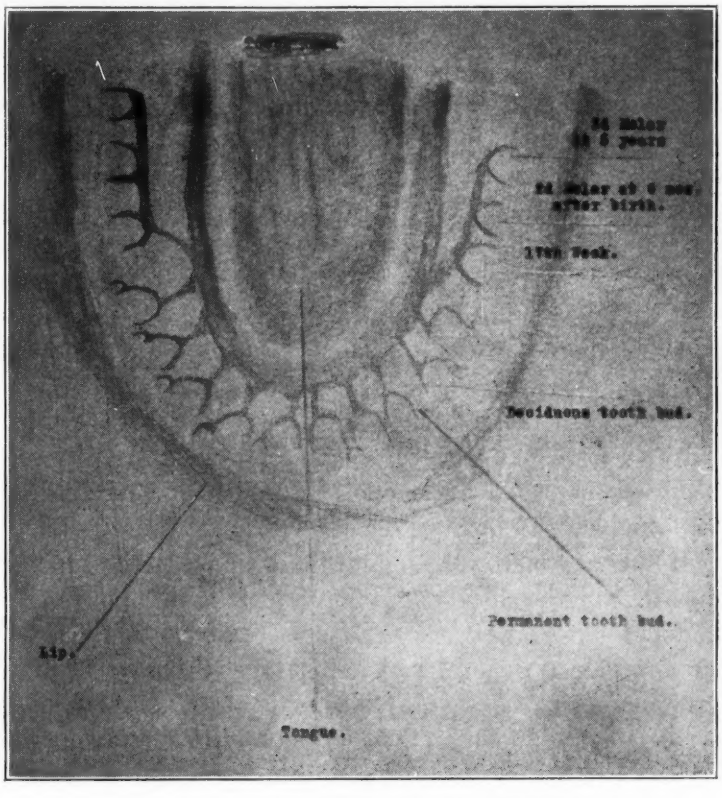


Fig. 2.

the underlying mesenchyma, it divides into a labial portion in front which brings about the separation of the lip from the gum, and a dental portion behind, which is concerned with the production of the teeth."

The further development of the dental portion is shown diagrammatically in Fig. 2.

"Almost as soon as the dental portion has formed, it produces a series of inverted cup-shaped enlargements along its labial surface, which become the enamel organs. There is a separate enamel organ for each of the deciduous teeth in either jaw, and they are all present in embryos of two and one-half months. They not only produce the enamel, but extend over the roots, so that they are described as forming moulds for the teeth which de-

velop within their concavities. The tissue enclosed by the enamel organ is a dense mesenchyma which becomes the pulp of the tooth and produces at its periphery, the layer of dentine."

"In the development of the three permanent molars, which develop behind the deciduous teeth on either side of the jaws, the dental lamina grows backward, free from the oral epithelium." Thus the enamel organ for the first molar is formed at about the seventeenth embryonic week. That of the second molar develops at about the sixth month, and that of the third molar at five years after birth.

A further splitting of the enamel organs of the deciduous teeth gives rise to additional enamel buds for the subsequent development of each of the permanent teeth.

DEVELOPMENT OF THE MUSCLES

Although the formation of the tooth band establishes the foundation of the dental arch and the rough outline of its ultimate shape, by no means does it predetermine the permanent shape of the fully developed arches, for the reason that at about the same time that the tooth organs are laid down, there are other structures which are in the process of formation and which materially affect and control the further development of the arches. These are the muscles of mastication and the bones of the maxilla and the mandible.

Newman states about muscle development, "That the first differentiation of the muscles from the mesoderm takes place under the influence of the nervous system, through the influence of the motor nerves." He proves this by his observations where absence of certain portions of the central nervous system has been accompanied by the total absence of the musculature which is normally supplied by the lacking nerves. That is, muscles first arise under the influence of the nervous system, but their nourishment and growth later become independent of the nervous system and it is later or after birth again that its dependence on the nervous system is reestablished. It is also stated that "the nerves are in a general way indicators of the position of the origin of many of the muscles." . . . "The site of entry of a nerve into the muscle, as a rule, marks the region of earliest differentiation and, in many instances, the distribution of the nerve within the adult indicates the course of development or growth of that muscle."

DEVELOPMENT OF BONE

Now in conjunction with muscle development we must also take into consideration bone development which is the structure we are mostly concerned with after the eruption of the teeth. Here we are likely to find some very interesting contrasts which may contribute to a clearer conception of the factors controlling occlusion as influenced by nerve, muscle and bone development.

In a six weeks' embryo the various muscles of mastication are recognized as definitely formed or rather differentiated as groups. Now if we should turn to the bones of the maxilla and the mandible at about the same period, we will find only certain parts of the bones beginning to develop.

At about the forty-second day, centers of calcification begin to appear at the ramus and various points of the maxilla, at about the fifty-fifth day the condyles are formed and at about the seventieth day the alveolar processes begin to form.

Summing up the various points brought out about the development of these various structures, we are confronted I think with sufficient evidence to form a more or less definite opinion as to the influence which they exert on the whole masticatory apparatus as the most likely primary factors controlling occlusion.

Thus we have embryologic and histologic evidence that:

1. Muscle differentiation takes place under the influence of the nervous system through the motor nerves.

2. Absence of certain portions of the central nervous system, or serious impairment of these centers is accompanied by total or partial absence of musculature which is normally supplied by the lacking or impaired nerves.

3. The nerves are, in a general way, indicators of the position of the origin of the muscles.

4. At the time the above have taken place, the bones of the jaws are just beginning to develop and calcify, but their complete calcification and thorough hardening does not take place until years after birth.

5. Functional activity of the muscles of mastication begins before birth. This is proved by the fact that months before the child is born it employs the muscles of the lips, tongue and mastication in sucking the amniotic fluid. While on the other hand the jaw bones do not begin to function until after birth and especially after the eruption of the teeth, when the habit of mastication is started.

6. Last, but not least in importance, is the fact that the development of the enamel of the second and third molars begins after birth, thus increasing the number of factors that are likely to interfere with their proper development and alignment.

CONCLUSION

The forces underlying the vital processes of development and their operation create the factors. It is, therefore, fair to asume that if these factors are *uninterfered with,* in the development of a child with a background of healthy normal parents, of similar tooth and feature types and racial characteristics, will operate to bring about a healthy child, propagating the same background, type and racial characteristics, they will, *if interfered* with by heredity, dissimilarity of type, ill-health, malnutrition, etc., produce deviations from the normal, and in a ratio analogous to the degree and manner of interference.

In other words, applying the same reasoning to the matter of occlusion, these factors constitute the inherent forces controlling a developing occlusion, and of necessity, if interfered with, will become factors in the bringing about of deviations from the normal, that is, malocclusion, and also, at times, *inherent anomalies* of function permanently established and working against our best efforts to eradicate them.

To be more specific, concerning the *inherent anomalies* of function which would be permanently established, permit me to use the following illustration:

Let us take a child where during the development of its head, especially the maxilla and the mandible, the right side is normally and fully developed, but on the left side the left maxillary palatine, sphenoid and all other bones

Fig. 3.

serving as attachments for the muscles of mastication, through some cause, either due to a defect in the nerve centers of the motor nerves supplying the muscles of that side, or due to pressure or any other likely cause, are distorted or have failed to grow properly, so that the origin of the muscles of mastication on that side are nearer the median line or rather the line of fusion of these bones than on the other side, and let us further aggravate this condition with shorter, weaker and ill-developed muscles on the same

side, and also a large active tongue. These factors, to my mind, will constitute inherent anomalies of function which would be permanently established; because, to correct such a condition we would have to establish greater function on the affected side and will have to apply our forces for bone stimulation from a fixed point independent of the other side. That is, a fixed point outside of the skull, which would be obviously impossible to do.

Fig. 4.

This, of course, is a purely hypothetical case, but by no means impossible. Similar complications are found quite often in other parts of the human body. In the orthopedic wards of the hospitals for children there are innumerable cases presenting similar problems of muscle function or lack of function and bone development. Their nature and location, however, would permit treatment, muscle exercises, and types of appliances which would be quite impossible to apply to the jaws or the head.

BALANCED OCCLUSION

There is little left to be said about balanced occlusion in natural dentures; but if you will permit me again, I will state another hypothetical case.

Let us take once more the head of a developing human embryo with an

Fig. 5.

ideal background as far as heredity is concerned. And for the sake of an argument, let us assume that the laws governing bilateral development seen in the higher forms of life are allowed to operate under ideal conditions, and that the child is born and reaches maturity unhampered by any of the ills common to the human race.

Such an individual, with such a background of uninterrupted ideal de-

velopment, will then present a symmetrically developed skull, with its pairs of bones symmetrically arranged around a median line, with the various groups of muscles similarly arranged, their points of origin and insertion geometrically the same for each corresponding half, with a uniform muscle tone prevailing on both sides. Coming to the teeth and the arches, we will

Fig. 6.

find them in a beautiful typal harmony with the features, the arches in absolute symmetry, the teeth on one side measuring to the scale in form and size with those of the corresponding opposite side. Having established these we will have both of the temperomandibular joints functioning alike, with the same condylar path inclinations, with identically the same right and left lateral thrusts, or, in other words, an ideal occlusion in perfect balance.

It would require an imagination more vivid than I possess to visualize such a condition; because we know that even though we can imagine such a scheme exhibiting ideal perfection, we do not expect to find it in actual existence.

We know that embryos do not develop in a vacuum. They do not grow isolated or immunized, so to speak, from extraneous interferences. From the moment they begin to develop they struggle for existence and development.

Fig. 7.

They are likely to be handicapped by all sorts of interferences and after they are born, another struggle begins, of which we, as members of the dental profession, are well aware.

The occlusal conditions as we find them every day, vary from a few almost *ideally beautiful and harmonious* ones, to a few *hopelessly distorted* ones on the other extreme end of the scale, with the intervening space embracing the vast majority of cases varying from what most of us prefer to call

"average normal occlusions" to the decidedly marked malocclusions, of which the number is alarmingly increasing with the increasing admixture of types and the burdens with which civilization and modern methods of living is taxing younger generations.

Absolute balanced occlusion, therefore, from the standpoint of bilateral development, as I have described above, would be inevitable. However, *ab-*

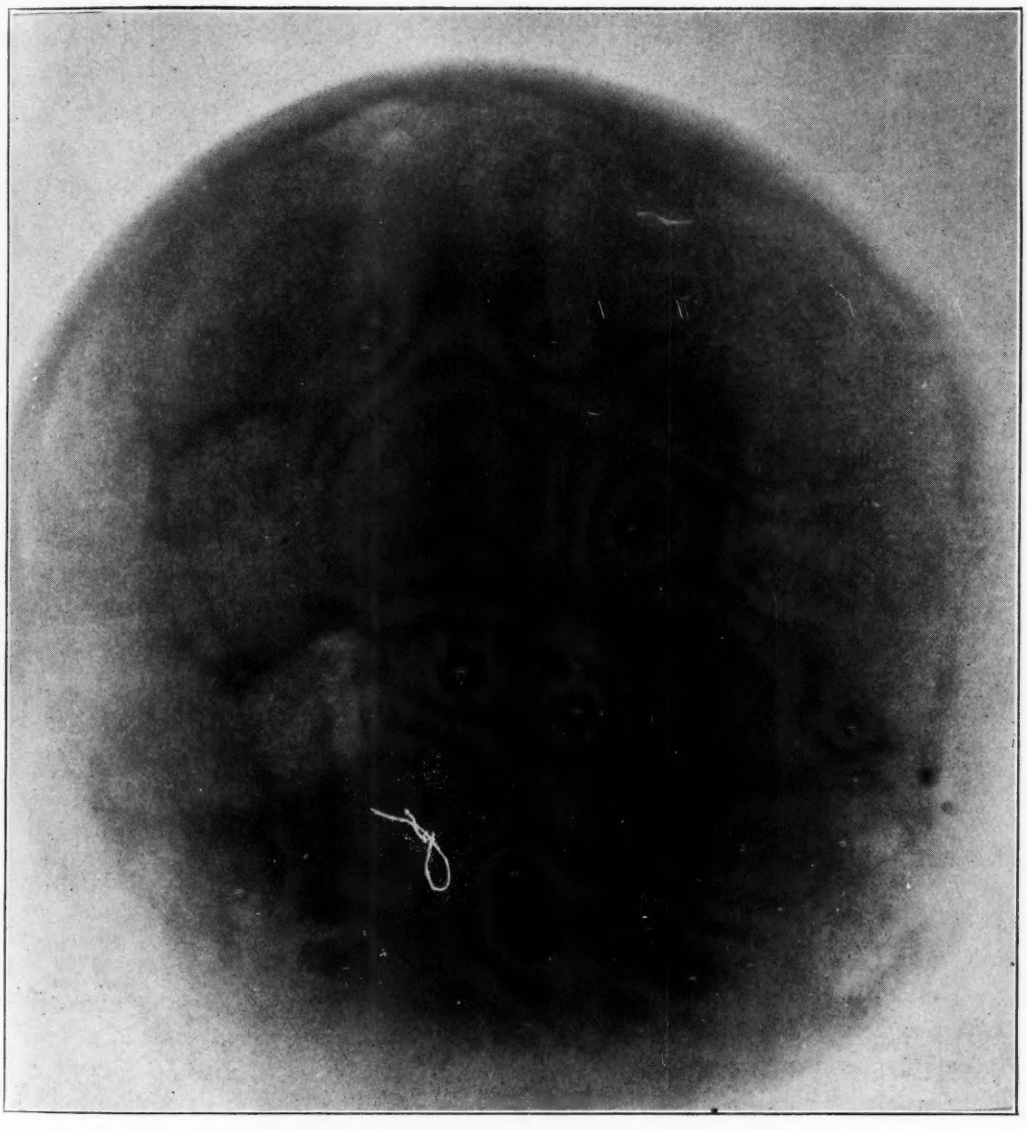
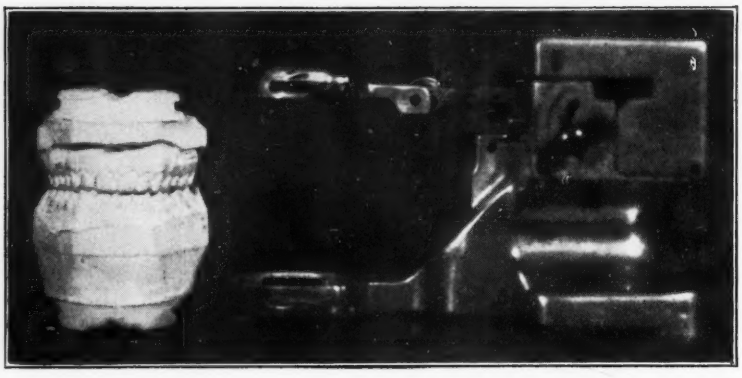


Fig. 8.

solute balanced occlusion from the standpoint of actual bilateral development as we see it every day would be hard to imagine.

Balanced occlusion, used as a phrase to denote the harmonious distribution of the functional mechanical stresses to which the teeth are likely to be subjected during use, is not to be found as commonly occurring in full natural dentures, where modern dietetic habits are not conducive of appreciable wear of the cusps of the teeth. It will, however, be found in a few cases



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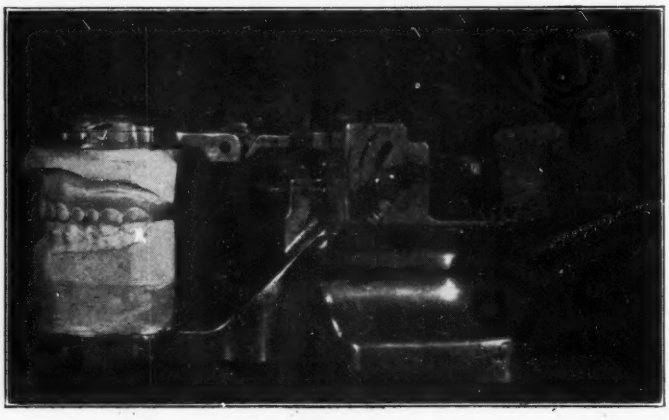

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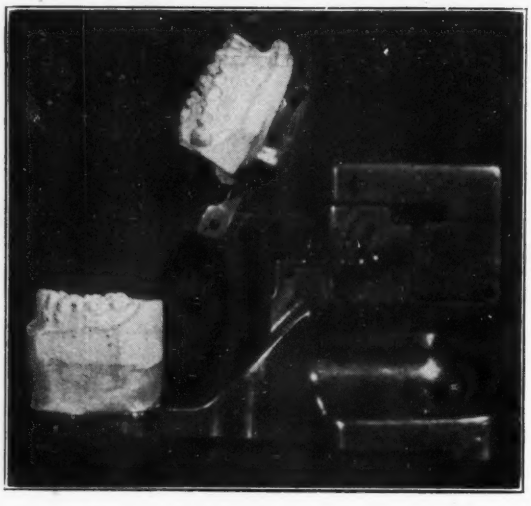


C

Fig. 9.—The Phillips Articulator. Designed to reproduce mandibular movements as executed by the patient. It records the exact condition of the temporomandibular joint. The models are mounted without the aid of a face bow and the records can be kept for future use.

relatively late in life, when the adaptive powers of the tissues give way to the retrogressive changes after maturity, and in instances where strong musculature in conjunction with coarse diet would bring about an appreciable amount of wearing off of the cusps of the teeth.

I do not want you to misunderstand me or confuse balanced occlusion in natural dentures with the balanced occlusion we so often hear discussed in prosthetic matters. Balanced occlusion in artificial dentures is an entirely different matter. It is a *mechanical necessity.*

In order to substantiate the few remarks which I have made tonight, I have endeavored to examine a number of orthodontic cases from the school clinic at the Harvard Dental School, taking their history, models and also anteroposterior radiographic views of the whole head, in order to detect any marked distortion or asymmetries in the hard structures, and compare these with similar radiographs of a few cases with *full natural dentures* which would be considered on the whole, as good average occlusions. I have also made models from these for the purpose of ascertaining to what an extent they would balance. These were tested with a pantographic articulator which I completed a few months ago. None were found to show balanced occlusion.

A gross examination of the anteroposterior views of the head of the persons who had good average occlusions, without a single exception, showed a remarkably beautiful bilateral symmetry, with a strikingly proportionate development of the maxilla to the mandible. Fig. 3 serves as a good illustration.

Using these as a control for comparison with those presenting malocclusions, I found that I could classify them under three main headings with their subdivisions, as follows:

I. Symmetrical: (a) Proportionately underdeveloped arches.
(b) Disproportionately underdeveloped arches.

II. Asymmetrical: (a) Proportionately underdeveloped arches.
(b) Disproportionately underdeveloped arches.

III. Distorted.

The following is a rough outline of information gathered from the anteroposterior radiographic views of the skulls of ten cases presenting average normal occlusions and of the fifty cases undergoing orthodontic treatment.

Fig. 4 shows bilateral symmetry, proportionate development of the maxilla to the mandible, but crowded arches, due evidently to underdevelopment of the bone.

Fig. 5 shows bilateral symmetry, but disproportionate development of the arches due to underdevelopment of one arch only in proportion to the other.

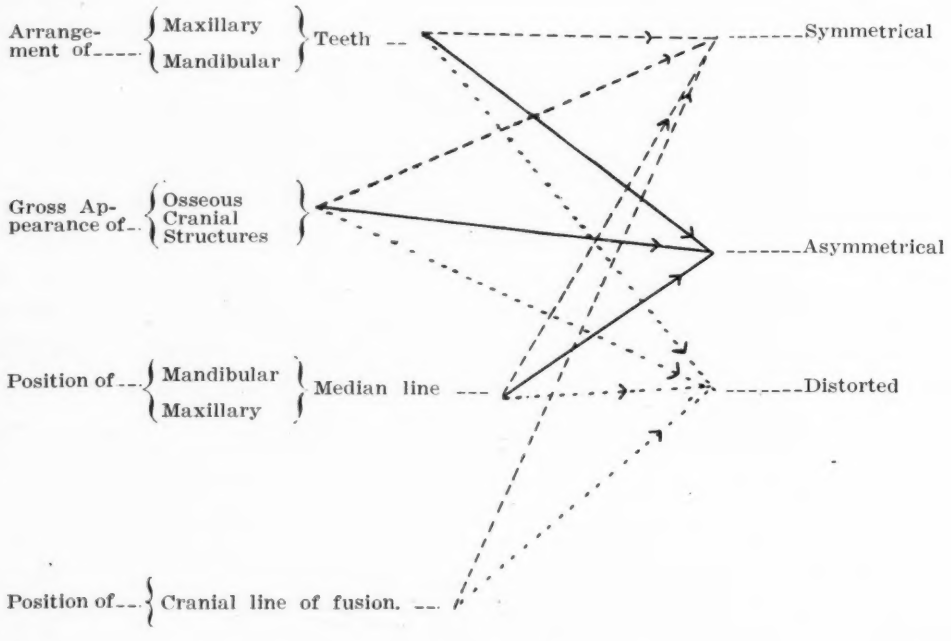
Fig. 6 shows a condition of bilateral asymmetry with a proportionate development of the arches, although both underdeveloped.

Fig. 7 shows a condition of bilateral asymmetry with disproportionately underdeveloped arches.

Fig. 8 shows distortion of the whole osseous structure of the head.

Although outside of the main scope of this paper, I am tempted to ven-

ture the opinion, that in Class I, all other things being equal, the prognosis for successful results in treatment will be good if proper bone development and normal function are established. In Classes II and III, however, I feel, that if the asymmetrical condition shown in the radiographs cannot be accounted for as being due to habit, loss of function on one side on account of extensive caries, premature extraction of teeth, or accident, or any other visible and accountable mechanical interferences, the prognosis for permanent good results will not be favorable; because, in such cases one will not only be combating underdevelopment of bone and loss of function alone, but also, an uneven, decentralized or perverted muscle action; a condition to which I have previously referred as an "inherent anomaly of function" permanently established.



I realize that these radiographs should not be accepted as conclusive proof. I do, however, believe that further study and investigation will reveal these conclusions as representing something fundamental to the prognosis of orthodontic cases, and possibly an additional contribution to the present knowledge of muscle development and function as related to the associated cranial structures.

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DISCUSSION

Dr. Russell W. Tench.—Dr. Phillips has presented a very interesting and stimulating paper. There is nothing in the way he has treated his subject with which I can take issue. His statements sound logical and his conclusions practical.

No doubt both the orthodontist and the prosthetist are frequently confronted with perplexing problems that have their origin in Nature's failure to achieve her ideal when conflict-

ing factors, inherited or accidental, set her a task which she cannot complete without external assistance. The orthodontist is able to assist Nature to a more or less satisfactory adjustment, at least in so far as the dentition, its supporting osseus structure and associated musculature will respond to his desire, expressed in the gentle urgings of his delicate appliances.

The prosthetist must accept conditions as they are, in the main, and as Dr. Phillips has said must build his appliances to harmonize with the conditions he finds when the patient comes to him.

The prosthetist and orthodontist must necessarily differ in their viewpoint regarding the diagnostic value of an adjustable articulator due to the wide difference that exists between the conditions under which they work.

If it is true, and I am convinced that it is, that because of difference in embryonic origin, a child may inherit the conformation and size of the teeth of its dentition from one parent and the osseous supporting and the soft tissue activating mechanism from the other, then it must be true also that the inherited cusp form may, in many instances, be such that there will be a disharmony between this form and the acquired tendency of the muscles to function in mastication. Such a conflict might seriously interfere with the permanence of a beautiful orthodontic result.

The visualization of such a hypothetical case is easy for the prosthodontist, for he has observed the destructive effect of deep cusp teeth that are not constructed to be in harmony with the habitual masticating movements of the patient who had them inflicted on him.

The manner in which the prosthetist uses an articulator in the construction of full dentures and the purpose for which he uses it constantly calls to his attention the evil effects of disharmony between the cusp form and habitual masticating movements. He must balance the occlusion of the dentures he constructs to all the functional masticating movements of the patient he is treating. If he does not, the effect may be immediately recognized, either in the lack of stability of the finished dentures, or in the trauma produced in the tissues supporting the denture or dentures.

When constructing a denture to function against a more or less complete natural dentition the prosthetist is usually forced to reform some of the cusps of existing natural teeth so that these cusps will function to as great an extent as possible and not interfere with the stability or usefulness of the artificial restoration. Errors in natural cusp form that interfere with ideal occlusion relations might require years to produce their destructive effect, as evidenced in periodontal disease or development of malocclusion.

In balancing the occlusion of dentures the prosthetist is not confined to individual teeth. He may balance all the teeth that oppose one another in function or he may elect to balance the pressure of the dentures on the supporting ridges by bringing a few teeth located at three widely separated points into harmony with the conditions presented by the patient.

Balanced occlusion as applied in orthodontia on the other hand would require the balancing of each tooth to harmonize with the movements directed by the musculature and bony framework involved in mastication, that each tooth may play its full part in the mechanism Nature placed it in.

I believe with Dr. Phillips that the fully adjustable articulator has a valuable field in orthodontia for study in a complete and convenient way of the probable causes of failure that might arise from disharmony between cusp form and inherited tendency to follow certain fixed paths in the function of the natural dentition.

The most feasible course that seems to present itself at this time would be to examine the occlusion of each case when its treatment has advanced to the point where further improvement seems to be impossible or when treatment has reached the stage at which the retainers would be applied.

Such an examination could be made in a good adjustable articulator after casts had been properly set in it and the mechanism adjusted to the patient's range of masticating movements. This adjustment could be effected by means of accurate protrusive and right and left lateral check bites.

It would surprise me if such procedure did not frequently disclose the necessity for reforming the occlusal surfaces of many teeth in a way that would assist in the retention of the orthodontic result obtained and also materially benefit the health and efficiency as well as improve the appearance of the dental mechanism.

Dr. J. Lowe Young, New York City.—Dr. Phillips very courteously sent me a copy of his paper in time to read it over before the meeting. I have carefully done this and, of course, there is a lot in it on the development of the muscles and the bones that we must agree with.

Dr. Phillips has made a statement regarding large teeth and small features that does not seem to be sound. I think every orthodontist in the country who has had years of experience could show many cases where, to the lay mind at least, it would look as though there were large teeth and small jaws. It would also be possible to show that these same cases when properly and intelligently treated by delicate mechanical stimulation do not appear to be of this character. It is rare indeed to find a case, if treated at an early age, where the teeth cannot be made to assume their proper position with the rest of the face and head.

We must not lose sight of the fact that the teeth before they erupt are as large as they are ever going to be. When we find a child with a full complement of teeth that have developed in normal relation, we will almost invariably find a child with a large mouth, one considered homely, but later when this child reaches maturity it will be found that he loses this large-mouthed appearance, due to the fact that the balance of his physiognomy has developed to normal.

No doubt we do find inequality of muscular development, as Dr. Phillips has stated, and I am satisfied that it is due to this that we incur such great difficulty in retention of certain types of cases.

Dr. Tench brought out the point that the cusps of the teeth are not always in harmony. With this I agree and in such cases as these the orthodontist is justified in grinding the cusps somewhat but this should be done with the greatest of care.

I agree with the essayist that balanced occlusion is a term only for the prosthodontist, but it is doubtful if we can find many normally developed cases that are in balanced occlusion as understood by the prosthodontist. It is not necessary that the natural teeth should be in balanced occlusion, but it would be beneficial if people properly used their muscles of mastication and lived on foods requiring thorough and vigorous mastication.

I am satisfied from my observation that each individual adapts his mandible movement very largely to the arrangement of his teeth. If this were not the case many cases of malocclusion would develop tremendous traumatic conditions.

Dr. Henry C. Ferris, New York City.—Dr. Phillips opens his paper with this statement, "The subject of balance occlusion and the factors contributing the same, are more or less obscure."

I would accept this statement if it read "abnormal balanced occlusion" or possibly, "compensated occlusion."

Dr. Phillips states that he has found a few reasonably normal cases, and these must be taken as our ideal of what Nature develops to accommodate deformity owing to faulty development. Any part of the anatomic structure becomes an individual study in pathology, and may present any one of a thousand variations.

I am confident, after making hundreds of dentures, that osseous or muscular tissues supporting them may be, and are, modified.

Opening the bite on one side and closing it on the other results in a rocking denture; but how many have we seen come to rest, after a month's perseverance on the part of the patient.

If it were not so, there would be many more failures in prosthetic, as well as orthodontic operations. Orthodontic treatment appears to be a little more perfect at the completion of the tooth movement until such time as Nature makes a compromise with her own adjustments, with a balance of mechanical forces.

We see our cases changing every month for some time after orthodontic operations, even in the adult, both in facial contour and condyle path. This is the result under treatment in both specialties.

The mechanical articulator is enabling us to register these alterations, and note the angle of the condyle paths and the points of traumatic occlusion. Dr. Phillips has presented to the profession one of the most perfected instruments for this purpose.

Fig. 1.—Before treatment.

Fig. 2.—After treatment.

Fig. 3.—Before treatment.

Fig. 4.—After treatment.

It must be acknowledged that many of our cases are benefited by retreatment after two years of physiologic function following either an orthodontic or prosthetic operation.

I have modified the condyle path by opening the bite unilaterally, and have used as many as four plates before I fully accomplished my desired facial restoration. This is not practical in every case, but when expense does not enter into the procedure, results can be attained.

Three adjustments were made in this case, over a period of two years, and I finally established a balanced occlusion. This was accomplished many years ago.

My recommendation at that time was that the patient should have new dentures re-

constructed after a period of two years, to maintain the balance accomplished, supplying material to make up the absorption of the alveolar tissue.

Heredity.—I am fully in accord with Dr. Phillips on the subject of heredity of osseous and muscular deformity; but I am firmly of the belief that balance of forces and excessive function on the deformed side in the growing subject will accomplish much in the restoration of the normal for the type of individual, provided the operation is undertaken at the age of six years or younger. Many pathologic conditions are modified through orthodontia and dental prosthesis but are seldom, if ever, recorded.

This experience, I believe, is concurred in by a great many of our orthodontists; and proved by our models and photographic records, provided that the ideal of the full denture is that being sought.

Histories of congenital defects running through three generations, such as missing laterals, premolars and molars, horizontal lines on the occlusal edge of the erupting "permanent" teeth,—are common in our practice in cases of syphilitic or alcoholic parentage.

Premature or delayed development of the teeth are both pathologic symptoms; the former associated with the precocious and the latter with the dullard child.

I have, however, seen the congenitally defective born babe with a very small mandible giving all prospects of a Class II, Div. 1 (Angle), develop, without treatment, with a remarkably normal countenance, and a normal breather, in spite of a posterior occlusion.

Dietetic stimulation and muscular function accomplishes remarkable restorations in what appears to be hopeless arrested development. The anteroposterior proportions are more apt to be restored than the lateral measurements in my experience. The miraculous results attained through orthodontic operations upon patients with a nervous pathology, has caused me to believe that the muscle stretching has been the stimulus for this correction, particularly when the muscles have been exercised until they have developed their highest potential.

I wish to thank Dr. Phillips for a very intelligent and instructive consideration of his subject.

ON THE TEMPOROMANDIBULAR ARTICULATION*

By Dr. Emmet Rixford, San Francisco, Calif.
(Professor of Surgery in Stanford Medical School)

BEING a general surgeon, I am somewhat embarrassed to talk about this subject before a society of specialists such as this body is, for I do not pretend to know much about the orthodontic relations of the mandibular joint, although I have had occasion once or twice to work with an orthodontist on problems connected with this joint.

I have been interested in the mandibular joint for a long time, because every now and then we find conditions connected with that joint which are of practical importance to the general surgeon.

The mandibular joint is almost unique in the body in some of its particulars and presents some anatomic features peculiar to itself. For example, it is the only joint in the body in which there can be a dislocation without rupture of the capsule. For the same reason, viz., the great extent and the laxity of the capsule, the mandibular joint permits an extraordinary variety of motions; in fact, there is hardly any other joint which will permit so many kinds of motions.

The mandible is moved straight forward by the combined action of the two external pterygoid muscles while, by the unopposed action of either, the bone is rotated to the opposite side, and by the action of these same muscles, together with certain others below called depressors, the mandible is rotated about an horizontal axis and the mouth opened. Closure of the jaw is effected by the action of the powerful temporal, masseter and internal pterygoid muscles, whose combined power is such that it is estimated that the force of mastication in the average adult with reasonably sound teeth is upwards of 250 pounds.

The grinding rotary motion of the mandible in mastication is especially interesting. The mandible as you know is normally much wider than the maxilla and the mandibular teeth point inward and the maxillary point outward. If one were to pass on each side a normal, to use the engineer's term, a perpendicular to the surfaces of the molar teeth and would imagine these lines to be prolonged, they would converge and meet at a point somewhere near the top of the skull. The motion of the mandible, then, in a lateral sense, may be considered as a rotation about this point as a center. But rotation about this center is only one component of this complicated grinding movement. In fact the mandible is not as a whole subjected to such pure rotation. The movement is always combined with rotation about a vertical axis under the alternating action of the external pterygoids.

The mandibular joint is divided more or less horizontally by an intra-articular cartilage or meniscus into two compartments. Possibly in old age

*Read before the Pacific Coast Society of Orthodontists, San Francisco, Feb. 16, 1926.

and from wear the cartilage may be thin in the center or even have a hole in it but as a rule the two compartments are independent of each other so that counting the two sides you have four joints taking part in these various complicated movements of mastication.

If one examines the inferior surface of the temporal bone he will find a concave socket which is apt to be looked upon as the main part of the joint; directly in front of it a smooth, round, wave-like ridge called eminentia articularis and behind a thin margin of bone ending in a sort of spur just in front of the external auditory meatus. It is interesting to realize that this hollow I have just described takes so little part in the joint function that it is not covered with cartilage except in its smaller anterior part, that part in front

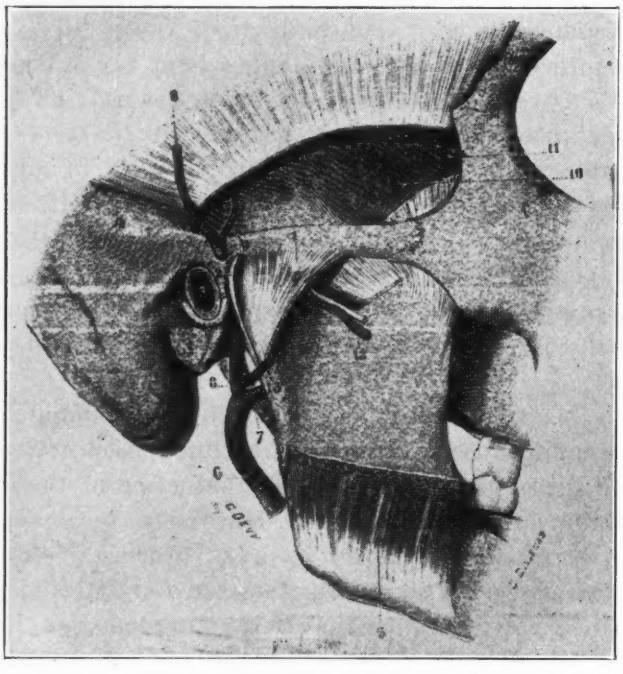

Fig. 1.—Lateral aspect of the region of the right mandibular joint (after Testut). 1, External lateral ligament; 2, posterior ligament; 3, external auditory meatus; 4, temporal muscle (divided); 5, masseter muscle (lower portion); 6, external carotid artery; 7, internal maxillary artery; 8, temporal artery; 12, artery and nerve of the masseter muscle; 13, transverse facial artery.

of the fissure of Glaser. The posterior part, embryologically part of the tympanic bone, is covered merely by thin periosteum. Its function is to contain the thick posterior end of the meniscus. Beginning at the fissure of Glaser, the cartilage runs forward over the eminentia articularis, sometimes called the condyle of the temporal bone.

The meniscus is somewhat wedge-shaped, being much thicker behind. It is concave above to fit the temporal condyle and below to accommodate the mandibular condyle. It is attached to certain fibers of the external pterygoid muscle which serve to pull it forward as the mouth is opened, and is armed with an abundance of elastic fibers connected with or emanating from the external lateral ligament which act as a sort of spring to retract the meniscus as the external pterygoid relaxes when the mouth is closed.

The mandibular condyle is not entirely covered with joint cartilage, the front only being covered.

The stability of the joint is furnished chiefly by the lateral ligaments, an internal and an external, of which the latter is much the more voluminous and stronger. Both are attached to the mandible along the posterior margin of the ramus near the level of the proximal orifice of the mandibular canal. The sphenomaxillary ligament covers the proximal orifice and is divided below for the passage of the mylohyoid nerve and artery.

In opening the mouth as in taking food, the condyle and meniscus move forward as far as the summit of the articular eminence.

The external pterygoid muscle being attached to the ramus in front in the hollow or fossa just below the condyle, pulls the condyle forward and has the effect of opening the mouth. The rotation of opening and closing the mouth takes place about an horizontal axis passing through a point in front

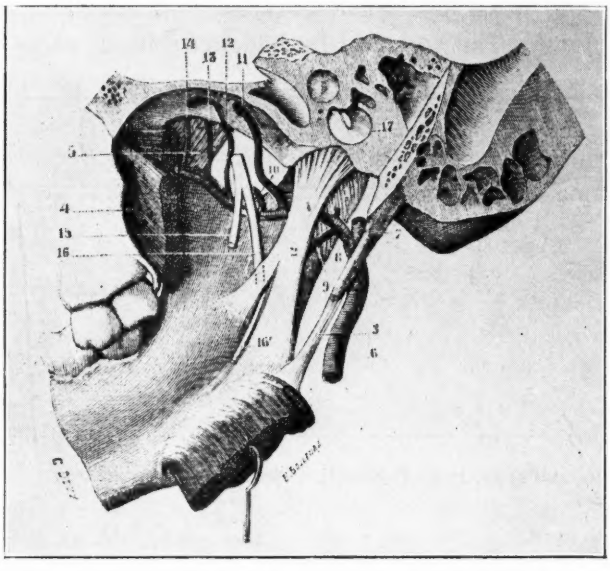

Fig. 2.—Mesial aspect of the region of the mandibular joint (after Testut). 1, Internal lateral ligament; 2, sphenomaxillary ligament; 3, stylomaxillary ligament; 4, internal pterygoid muscle (divided); 8, internal maxillary artery; 9, inferior dental artery; 11, middle meningeal artery; 15, lingual nerve; 16, inferior dental nerve; 16′, nerve to the mylohyoid muscle; 17, membrana tympani (internal surface).

of the insertion of the lateral ligaments on the mandible almost exactly at the place where the mandibular nerve enters the inner side of the bone. Now it is a very extraordinary ligamentous apparatus that will permit this peculiar sort of motion, or series of motions. These motions are restrained or limited largely by the external and internal lateral ligaments, which are of triangular form, base arising from the zygoma and the inner edge of the glenoid respectively, their apices below. The fibers converge to be inserted along the posterior margin of the mandibular ramus. The fibers of both the external and internal lateral ligaments are directed downward and backward and are therefore relaxed as the condyle comes forward in opening the mouth or, more accurately, the tension on the lateral ligaments is maintained at an almost constant point, this relaxation just mentioned being balanced by

tension resulting from elevation of the condyle on the eminentia articularis in which an engineer would see a beautiful example of a cam. The posterior part of the external lateral ligament contains many elastic fibers so that it acts almost like a spring and is described by some authors as a brake to the movement forward of the condyle when the mouth is opened.

In dislocation of the jaw, which is ordinarily forward, the condyle passes in front of the eminentia articularis. Dislocation may be unilateral or bilateral. Of course it ordinarily occurs as the result of excessive opening of the mouth. Sometimes boys are ambitious to see whether they can get whole apples into their mouths, or to see which can take the biggest bite. The jaw is dislocated in consequence.

I heard an amusing story told by Bishop Hale of the Episcopal Church in Alaska. He said that when he went on one of his long excursions he had to leave somebody in charge. There was a young Indian there who was rather clever as a mechanic whom he had taught how to handle broken legs, dislocations, etc., and when he returned from one of his excursions he asked the boy how he got along. The boy said he had had lots of cases, so many broken

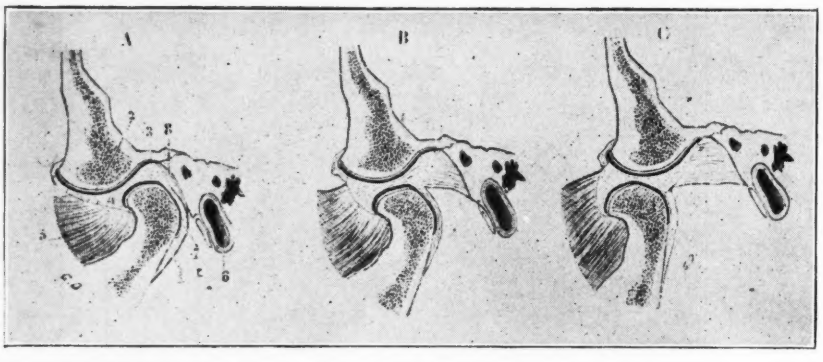

Fig. 3.—The mandibular joint in sagittal section (after Testut).
A. Mouth closed.
B. Mouth open.
C. Mouth wide open.
1, Mandibular condyle; 2, condyle of temporal (eminentia articularis); 3, glenoid cavity; 4, meniscus; 5, external pterygoid muscle; 6, external auditory meatus; 7, posterior ligament.

legs, so many broken arms, this, that, and the other, and finally he told about a dislocated jaw. "Well, what did you do for the dislocated jaw?" the Bishop asked. The boy said, "I didn't do anything. I left it alone." "Why did you not put it back?" "Oh, she was an old woman. She talked too much."

Here is another sidelight on that aspect of the case, since we are telling stories, and that is that this spine of the temporal bone just in front of the ear is the point of attachment of some of the fibers of the external lateral ligament and once in a great while from a blow on the chin, the condyle will be thrown back and be caught under that spine. This spine is more developed as a result of excessive use of the jaw and this is said by some to be the explanation of the fact that posterior dislocation of the jaw has never been observed except in elderly females.

The jawbone, as you know, is probably the most plastic bone in the body.

It is wonderful to what extent it can be bent and twisted and turned and straightened, and so on, under continuously applied force. I was never more struck with that than in having a child brought to me who had been burned about the face so that the chin was pulled down upon the chest by the scar. The little girl's jawbone, instead of being of the normal shape, was bent down so that the molar teeth would occlude but the incisors would not come within three-quarters of an inch of meeting. I can see therefore, as a general surgeon, the fundamental principle on which much of orthodontia is developed, namely, the plasticity of the mandible.

In the development of the mandibular joint and of the mandible itself, there is a great deal that is of interest. In the first place, congenital defects are not common. We speak often of micrognathia as an evidence of congenital defect. There is no reason to suppose that this nondevelopment of the mandible is a congenital defect in any considerable proportion of cases, because inflammation of the mandibular joint, especially if leading to ankylosis with or without destruction of the epiphyseal cartilage, seems to halt the development of the jaw. If you will go carefully into the history of the cases, you will find in most of them that the jaw was normal until the child had an attack of otitis media, perhaps in very early childhood. The inflammation of the ear is transmitted to the mandibular joint because in the young child there is merely a thin shell of bone between. We are recently finding that mastoiditis and otitis media, almost without symptoms, is more common in infants than previously thought. For example, the other day I operated on a little child, four days old, for cleft palate and as a result (I suppose through my stitches, although I used gold-plated wire which is about as nonirritating a thing as I could find) some infection occurred and the child went down and down. We could not make a diagnosis as to where the focus of infection was. We knew it was somewhere but nothing was showing locally and Dr. Faber of Stanford University, Professor of Children's Diseases, had recently been reading an article by somebody who showed that mastoiditis is much more common in infancy than thought for and, while there were no symptoms of mastoiditis, we got the specialist to look into the ear and he found the drum head on both sides bulging with pus, although the baby was only two weeks old. There are no mastoid cells in a baby of this age except the antrum and we opened the antrum and found pus with culture of staphylococcus.

There are other more clearly congenital anomalies. For example, sometimes there is an absence of the condyle, or an absence of the joint. In such cases we are apt to have other congenital anomalies in the neighborhood, such as a crumpled ear or the absence of the middle ear, or the absence of the external ear. It is the rule rather than the exception that such congenital defects are not single but multiple.

Now the reason for that particular congenital defect nobody knows. Possibly a uterine fibroid pressed on the ear, but most explanations of congenital defects are rather far-fetched. For instance, it has been suggested as a cause of harelip and cleft palate that the baby put his fists into his mouth at a time before the cleft closed. The objection to that theory is that the fists

are not fists at the time of closure. They are merely little buds on the trunk and could not possibly be put into the baby's mouth.

The joint is subject, of course, to inflammation the same as other joints in the body but perhaps not to the same extent. Acute inflammation occurs by direct extension from the middle ear or from the auditory canal. Inflammation may occur as a result of a blow on the chin which perhaps breaks this thin partition of bone and opens up the middle ear. Sometimes in cases of injury from a severe blow on the chin, if one will look into the ear with an otoscope he will see, not merely blood, but sometimes bits of bone. Even the condyle has been seen in the auditory meatus after a blow on the chin. Certain inflammations are, therefore, due to trauma; others to infection by continuity and still others to blood-borne bacteria. Of course all of these things apply to other joints as well. So much for acute inflammation except that the results of acute inflammation depend on the relative virulence of the infecting organisms. Perhaps the great majority of joint inflammations subside under hot applications and rest, but if there is actual suppuration in the joint, ankylosis is almost sure to result.

It may be of interest to the orthodontist to know that, while chronic arthritis is common in the wrist and knee joints, it is rare in the mandibular joint. I do not know why. Gonarthritis, for example, is most common in the knees and next in the wrist but almost never occurs in the mandibular joint. Thus ankylosis, resulting from chronic arthritis, is much rarer in the mandibular joint than elsewhere.

Of course in some sense we look upon the mandibular joint as the most important joint in the body. Doubtless it is to some people. Up at Martinez in the County Hospital there is an Irishman who was formerly a schoolteacher—a most interesting man. He was afflicted with chronic arthritis and every joint in the body was affected. He only had two joints that would move—the mandibular joints. There was in addition the merest modicum of motion of the right shoulder. The nurse would put a pencil between his fingers and put a piece of paper up in front of him and by means of a wiggle that he would give to his shoulder, he was writing his autobiography. With the movement of the mandibular joints, which was in no sense inhibited, he was running the politics of Contra Costa County.

One of the most interesting cases of ankylosis of the mandibular joint which I have seen was of a sailor who, fourteen years before, had awakened one morning in the hospital at Valparaiso with a stiff jaw, two or three weeks after his ship had sailed. The most that he could find out about what happened to him was that while he was at work down below under the hatch a box of freight fell and hit him on the head. For these fourteen years he had not been able to open his jaws at all. He had a semblance of mastication by shoving his teeth sidewise. It was therefore a case of ankylosis due to damage to the soft parts and not bony. Inasmuch as he had a scar down the temporal muscle I thought it was probable that a corner of the box of freight injured his temporal muscle and then infection occurred and enough scar tissue developed in the muscle to prevent opening the mouth. I therefore advised an operation which I thought would relieve the trouble. I put

my fingers inside his cheek and felt the coronoid process of the jaw and prepared to cut off the attachment of the temporal muscle. I incised the mucous membrane and isolated by the touch the tendon of attachment of the temporal muscle and put in my scissors to cut it off. The scissors struck something hard, gritty, and I thought of a misplaced tooth; perhaps an unerupted molar which had gotten out of place, though I never knew of a molar so far out of place as that. With a pair of forceps I got the gritty thing out and found it to be a piece of window glass half an inch wide and an inch and a half long. Then I went in again and pulled out altogether about a tablespoonful of bits of window glass, after which there was no difficulty whatever in opening his jaw. When informed of what we had found the sailor said, "Yes, they told me that box of freight was a box of window glass."

There is still another cause of pseudoankylosis, and that is what the books talk about as hysterical contraction of the muscles of mastication. Hysteria will sometimes cause the patient to hold the jaw set so you have got to be smart to exclude organic ankylosis. Again, on a purely neurologic basis, I understand it is possible to have a contraction of the muscles that close the mouth, as a result of some irritation of the third branch of the fifth nerve. I am reminded of a case my dentist told me about of an impacted third molar which, while it caused no neuralgia, did cause some nervous influence which resulted in a spasm of the other muscles innervated by the third branch of the fifth nerve. He proved it by injecting novocaine into the mandibular nerve just before it entered the jaw and when the nerve was thoroughly anesthetized, the patient, a young girl, had no difficulty in opening her mouth.

The treatment of ankylosis of the mandibular joints makes a very interesting chapter in the history of orthopedic surgery. That is, the need of making it possible for a person to open his mouth set surgeons at work very early to solve that problem. It was just one hundred years ago when Rhea Barton, an American, made the first attempt by operation (osteotomy) to relieve ankylosis, but doubtless longer ago than that, simple force was used to yank the jaws open, or by means of a dilating instrument with a screw on it gradually to force the jaws open. But, for bony ankylosis, none of these things would answer and it was necessary not merely to cut the bone but to prevent the bones again uniting. As a matter of fact the history of the development of the treatment of ankylosis of the joints in general really starts with treatment of ankylosis of the mandibular joint. Ollier in France cut away a large amount of bone, enough to permit the fibrous tissues to grow between the ends of the bones before the bones had time to unite, but Verneuil devised operations in which they not merely cut the bone but also implanted foreign material. A history of this work was given in the Paris thesis of Huguier in 1905. Nélaton used muscular tissue, a flap from the temporal muscle, or better, from the masseter muscle. Now we make a free transplant of fascia lata. If one can do an aseptic operation he can produce a new joint by putting over the end of any bone that makes a joint, a free transplant from the fascia lata, and that will limit the growth of the bone and prevent a recurrence of the ankylosis.

It is a pretty widely accepted principle in physiology that if an organ is not used it will atrophy. I suppose there are exceptions to that, but it is true of the bones. If we want a fracture of the leg to unite, we make early functional demand. If we are fortunate in having a transverse fracture, we will get the man up before the bone is united by putting on a proper splint to prevent bending. Early functional demand, I believe, is a most important principle in the treatment of fractures. So in the case of the jaw. The development of the jawbone depends very much upon its use. Now, if the jaw is ankylosed, it cannot be used and will not grow. So one would feel that if one has a child with ankylosis of the jaw, some operation for the relief of the ankylosis ought to be done early in order to permit the jawbone to grow. The jawbone grows from an epiphyseal cartilage which lies in the condyle. If that epiphyseal cartilage is destroyed the jawbone does not grow as it should. Any operation for the relief of ankylosis in the child ought therefore not contemplate the cutting of the bone near to, or damaging, that epiphyseal cartilage; the operation should leave the condyle intact. It is not always an easy thing to find the joint and free it without injuring the epiphyseal cartilage and there is always danger of injuring the facial nerve. One has to be cautious in his work because otherwise he is apt to destroy the nerve supply of the muscle that closes the eye.

A short jaw is the result, not so much, as I said in the beginning, of congenital defect, but of some damage, traumatic or inflammatory, of the mandibular joint or the epiphyseal cartilage, or to something that interferes with the use of the bone.

Of course the changes in the form of the jawbone which take place between early infancy and adult life are tremendous. The jaw in the young child is almost horizontal; there is hardly any angle to it and the angle develops as the child grows. Particularly does it increase along about puberty or later when the large secondary molars come in.

Tumors of the region are not very rare. Indeed you may have any sort of tumor in or about the joint, you may have tumors in the parotid gland, so-called, mixed tumors which may be hard and big enough to modify by pressure the shape of the mandibular condyle. You may have tumors of the bone itself, and tumors arising from the cartilage and other joint structures. Of course we have benign tumors and malignant tumors. As an illustration of benign tumors, a case in which I operated last year, might be of interest to you. A lady noticed that her cheek was getting big, a lump was forming in the region of the mandibular joint and she had increasing difficulty in moving her jaw. There was no pain. Gradually, however, her teeth on that side separated and she was articulating only on the right side and then she consulted an orthodontist, who put in some stilts, I do not know what you call them, extension teeth, so she could chew. She was able for a time to eat, but after a while the extension teeth had to be elevated or lengthened in order to secure contact. About this time she consulted her physician who looked upon the case in a more serious way. The physician feared that the tumor might be sarcoma and he realized that it was not merely a matter of orthodontia, it was a matter of life and death. Being unable to chew was the

least of her troubles. The x-ray plate showed a bony enlargement of the condyle. As you know, the mandibular joint is one of the most difficult joints in the entire body to satisfactorily radiograph, but we were finally able to get some stereoscopic pictures that showed it pretty well and after studying the history of the case it seemed rather to exclude sarcoma in favor of some more slowly growing tumor. We opened and removed the condyle and tumor and I brought it along thinking you would be interested in it. You see here was osteoma growing from the anterior surface of the condyle. The great hollow in front below the tumor is for the insertion of the external pterygoid muscle and you can see how the bone was limited in its growth as it lay on the top of that muscle.

Unfortunately in the removal of it, it was exceedingly difficult to get down low enough to cut the neck of the bone. Ordinarily you can take out the condyle very easily without damage to the facial nerve, but when the condyle is pushed downwards half or three-quarters of an inch, as in this case, the difficulties are very great. It was not feasible to put a chain saw around it or a Gigli wire saw because you cannot control these instruments. They may cut on all sides. So we had to cut it with a chisel and with bone forceps, and, notwithstanding the greatest care, damaged the facial nerve so that there was considerable facial palsy which lasted for a number of months. I feel sure that the nerve was damaged by traction of the retractor and was not cut, but I do not know what the final outcome has been.

Malignant tumors such as sarcoma are, of course, serious matters. They require the very best surgical skill and courage. The prognosis depends on the precise form of the sarcoma because the so-called giant-celled sarcoma, if that tumor is sarcoma at all, is amenable to surgical treatment. We cut it out and scrape it and it does not recur. The true periosteal sarcoma, however, is a wicked thing and for that hardly anything is justifiable except removal of a large part of the mandible.

DISCUSSION

Dr. Robert Dunn, San Francisco.—Many years ago the importance of the temporomandibular articulation as a factor in malocclusion of the teeth was impressed upon me when treating a case of malocclusion of Class III subdivision, and which proved to be a unilateral luxation of long standing. A sudden return of the mandible and condyle head to their normal positions occurred after certain changes had been made in the form of the dental arches and the use of intermaxillary ligature. This experience caused me to more closely observe the possibility of the mandible and the temporomandibular articulation as common factors in a large number of cases. My conviction has been further substantiated in my study of arrested vertical development in molar and premolar region and my observations of the development of the dental apparatus of young children, deciduous and permanent, in which there is a malocclusion belonging to Class II and their subdivisions in which there is shifting of the mandible, as it were overnight or between visits.

The possible changes in the mandible, the temporomandibular articulation, and the movement of the teeth in the dental arches in cases of distoclusion are much mooted questions. There are some who believe that the change takes place in the temporomandibular articulation, others, that it takes place in the angle or ramus of the mandible, and others who believe that the teeth shift in the alveolus with a changed position of the mandible. I place little credence in the last-named theory, and believe that if any shifting of the teeth does occur, it is long after the distal position of the mandible has taken place. Further,

after years of study and observation of the developing dental apparatus, noting the suddenness with which the mandible changes its position both bilaterally and unilaterally, and the early age at which it occurs, I have concluded that what actually takes place is a change in the relation of the condyle head to the glenoid fossa. The synovial membrane and articular discs make such possible with a bending or twisting of the neck of the condyle and a possible change later in the angle or ramus of the mandible.

This capability of the temporomandibular articulation in very young children to adapt itself to forced changes in position of the mandible accounts for the conditions known as subdivisions or bilateral distoclusions and is nothing more or less than a bodily rotation of the mandible with a bending and twisting in the neck of the condyle and changes in condyle head relation. The inception of these distoclusions usually occurs before the eruption to occlusal contact of the first permanent molars. The writer believes that the synovial membrane in the temporomandibular articulation has other functions than those commonly attributed to it.

In cases of ankylosis I do not believe that an orthodontist can ever hope to obtain anything like satisfactory results by treating such through appliances, for the best he can do is to shift his teeth through the alveolus, leaving the mandible practically as originally; he would be of greater service by giving such cooperation to the surgeon as may seem of value in the case.

I am showing two cases: The first where a slight improvement occurred through a shifting of the teeth through the alveolus.

The other where considerable improvement is noted, but which later almost entirely returned to the original condition. I never saw the case after that. Dr. Rixford undoubtedly will recognize it as one he afterward operated upon. Perhaps he will tell us something further about it.

That is all of Dr. Dunn's remarks, Mr. President.

President Carter.—We are running pretty well into the time allotted for the next number on the program and we will have to discuss this paper pretty snappily to get through before making it necessary to run way over into the noon hour.

Is there anyone that would like to volunteer to continue the discussion of Dr. Rixford's paper. Dr. Ketcham, have you any thoughts?

Dr. A. H. Ketcham, Denver, Colo.—My knowledge is too limited to discuss this subject properly. I can only cite two cases: One is of a boy who, at two years of age, suffered from scarlet fever and as a result was afflicted with ankylosis of the left temporomandibular articulation. The surgeon operated, leaving the head of the condyle up in its articulation and placed some connective tissue in between the remains of the mandible and that portion which contained the head of the condyle. The boy was presented to me at four years of age and the mandible, of course, was drawn backward upon the left side. There was partial ankylosis. You could open his mouth, to but a very slight extent. It was exceedingly difficult to reach his second deciduous molars and apply bands. The chin, as Dr. Rixford has mentioned, had not developed and was absent when viewing the profile from the left side. The maxillary arch was a typical V-shaped arch, with a protrusion of the deciduous incisors. The results of orthodontic treatment had been most happy. Eight years have elapsed since the institution of orthodontic treatment and he has now erupted his second permanent molars. His teeth are in normal occlusion and he has a very fair chin. He has some abnormal lip action, constantly moistening the lower lip as many children do who live in dry climates.

I will tell you of another case: A girl was presented at about eight years of age for treatment. When she was an infant, in a fall from a baby buggy, she received a blow upon the chin toward the left side. Dr. Carmody, an oral surgeon, referred the case to me. He reported that there must have been a bending of the mandible with even a green-stick fracture. There was a great deal of ankylosis and it was extremely difficult, almost impossible, to fit bands to the second deciduous molars. The case has been under treatment five years. The second permanent molars, are erupted. The teeth are in practically normal relation. The mandible has not developed, and there is still partial ankylosis, but not as

bad as at the beginning of the treatment. Dr. Carmody suggests the insertion of part of a rib to build a chin.

Dr. Carter.—Are there any further remarks?

Dr. James D. McCoy, Los Angeles.—I would like to ask Dr. Rixford if rickets has any effect on the form of the mandible?

Dr. Allen E. Scott, San Francisco.—Some of my friends claim that when the teeth wear down, and the bite closes that by opening the bite, in a great many cases, they are able to relieve deafness. I would like to ask Dr. Rixford if he believes that there is anything in this.

Dr. J. Camp Dean, Oakland.—The doctor referred to the fact that it was difficult to know at what time to operate. I have a case that I have been treating for about four years, where there was partial ankylosis by injury, and the case seemed to respond very nicely by working with the ligatures and bringing the mandible forward and opening the bite. That has discontinued and now it is going back to a more rigid condition and it is necessary to use considerable force to open the mouth. It seems to be closing. I formerly could get my fingers in his mouth so I could put bands on the mandibular teeth. It is almost impossible to do that now and it seems to me, if we are going to be able to have him take food comfortably, something will have to be done. The case will have to be referred to some surgeon. There seems to be a perfect rigidity of the joint. The patient was about eight years old when he came to me and now he is twelve.

Dr. P. T. Meaney, Portland.—I would like to have Dr. Rixford explain a little further about the middle ear. Can you have enough inflammation of the cartilage to interfere with the development of the mandible?

President Carter.—Any further cases?

Dr. A. H. Ketcham, Colorado.—I would like to ask Dr. Rixford in regard to the lime deposit in the bones.

Dr. Emmet Rixford, San Francisco.—One very important thing was brought up by this question about the lime salts in the bone. I mentioned some of the causes of nondevelopment of the mandible but I didn't mention the influence of traumatic arthritis, except in so far as it might cause ankylosis.

It is rather a new conception that arthritis of traumatic origin through nervous influence, just what we don't know, has a tremendous influence in determining the growth of bone and particularly in the matter of absorption of lime salts. That is not altogether a new conception, but there has been a good deal of attention given to it recently in the literature.

I am reminded of a case that was reported away back in 1895 of a woman who had received a blow on the mandibular joint and thereafter the whole articular process disappeared so that there was no bone at all. That thing is of tremendous importance in industrial accident relations because if it can be shown that bone will disappear or atrophy under the influence of traumatism of a joint, and I believe it can, some men are due for more compensation than the insurance companies perhaps think at the present time.

The question of the absorption of lime salts as a result of simple nonuse is, of course, a very well understood fact and it is well recognized that any bone which is not used for a considerable length of time loses its lime salts so that it becomes so bereft of lime salts that you can put your knife, or, in exaggerated cases, a blunt pair of forceps, into the bone. The bone is gone, as a bone; it makes little or no shadow with the x-ray. There is no doubt in my mind that that same thing occurs in the jaw. Our understanding of it and our grasp of it is complicated by this other notion of the nervous influence due to traumatism of the joint, a matter which is coming more and more into prominence.

So I apprehend, in view of that case I have quoted as occurring in the German literature where a blow on the joint was followed by complete absorption of the articular process

of the jaw, that inflammation of the mandibular joint, whether of traumatic origin or not, has through the nerve mechanism some important relation to the nutrition of the bone.

On the question of deafness—that catches me unaware. I do not see any reason for it unless through some very roundabout nervous mechanism. I do not believe there is anything to it but I would be very glad to be convinced about it. I would like to see the experiment tried and I would like to know how Dr. Ryan's deafness comes along.

Of course the other question about otitis media, I thought I answered that in my first talk—that otitis media, by causing congestion of the joint even perhaps without actual invasion of the joint by microorganisms will interfere with the growth of the bone.

LOCK*

By G. F. Cale Matthews, Birmingham, England

A VERTICAL wire (gauge 21 or finer) is soldered on the lingual surface of the band. A horizontal saw cut through the wire, sufficiently wide to engage the lock wire, is made.

The lock wire may be a continuation of the main spring (as on model); or independently soldered to the arch.

Fig. 1. Fig. 2. Fig. 3.

If the lock is correctly tempered, it springs automatically into the groove, and is easily sprung out for removal of the arch.

There is little risk of detachment or injury to the gingivae.

*Clinic presented before the First International Orthodontic Congress, New York City, Aug. 16-20, 1926.

ORTHODONTIC PRINCIPLES IN MAXILLOFACIAL RESTORATION*

By O. Rubbrecht, M.D., Ghent, Belgium
Professor, University of Ghent

I. THE MOST GENERALLY USED APPARATUS IN THE TREATMENT OF FRACTURED JAWS

EXAMINING the question of the treatment of fractured jaws in different textbooks, one is struck by the multitude of published apparatus and by the wide divergencies between the several writers. Nearly every author has his own special opinions about that subject. A similar situation existed in orthodontia about forty years ago, when no generally accepted rules governed the choice of the apparatus to be used in most cases. The introduction of systems of treatment brought a thorough change in the conception and practise of orthodontia. Nowadays the question of systematizing treatments is understood by the profession in a broader sense than a few years ago. Notwithstanding this fact, almost all modern textbooks on orthodontia contain the same teaching about the appliances to be used. A small number of types of apparatus have prevailed and are used nearly universally, according to the indications of the cases.

Most apparatus for the treatment of fractured jaws are or have been used in orthodontia. It seems interesting to examine these apparatus in the light of modern principles of orthodontia and to see in how far their use is in accordance with or contrary to them.

Fig. 1 is taken from a textbook on orthodontia published by O. Walkhoff[1] in 1891. The apparatus which it represents was intended to move labially, a certain number of anterior teeth and is shown at a moment when this result has been obtained. It consists of a flattened wire extending, on the maxillary jaw, from the second premolar of one side to that of the other side, and attached to the teeth by means of ligatures. According to Walkhoff, this kind of apparatus was probably used first by Fox and was adopted, later on, by Flagg. Such apparatus are, since many years, discarded in the practice of orthodontia, where even their remembrance has almost disappeared.

Fig. 2 is taken from a textbook on the treatment of fractured jaws, published in 1925 by R. Duchange.[2] The apparatus which it represents is exactly the same as that seen in the preceding figure. It is really described as an emergency apparatus, but the author esteems that, in conjunction with another similar arch on the opposing jaw, it can in most cases stay in the mouth during the whole period of treatment and that it can be, all that time, a most satisfactory apparatus.

The reasons why the simple arch wire, fixed to the teeth with ligatures, has been abandoned in orthodontia are its lack of fixity and the fact that

*Read before the First International Orthodontic Congress, New York City, August 16-20, 1926.

devices have been found which remedy this inconveniency. The question of fixity of the apparatus is no doubt of greater importance in the treatment of fractured jaws than in orthodontia. If we treat such cases, we must avail ourselves of every progress made in orthodontia, since the moment when the simple flattened wire, fixed to the teeth with ligatures, was replaced by apparatus giving every warrant of fixity.

Fig. 3 is taken from the third edition of S. H. Guilford's *Orthodontia* published in 1898[3] and represents Matteson caps. Fig. 4 is taken from the textbook on fractured jaws by Duchange and represents encapping splints in cast silver. Such appliances have been most extensively used during the war and are recommended in most textbooks treating on fractured jaws.

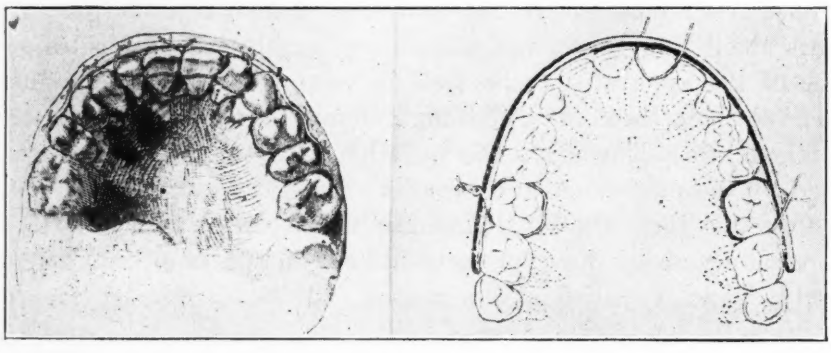

Fig. 1. Fig. 2.

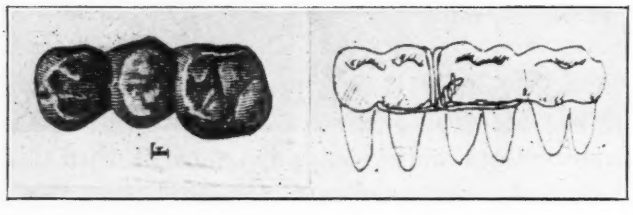

Fig. 3. (After S. H. Guilford.) Fig. 4. (After R. Duchange.)

The Matteson caps and similar means of anchorage have been abandoned in orthodontia, because they interfere with the occlusion and because their fixity is not reliable. Encapping splints present the same inconveniences in the treatment of fractured jaws as in orthodontia. They take away every control of the occlusion of the teeth. There is great danger that, after their use and consolidation of the fracture, the teeth will have lost more or less their former occlusion. It may be conceded that, when cemented upon a large number of favourably shaped teeth, the encapping splints give reasonable conditions of fixity, but no orthodontist could admit that they take hold of a single tooth or say how many teeth are necessary to obtain with them, a good fixation.

Fig. 5 is taken from a book, published in 1842 by Schange[4] and shows a method of anchorage upon the second right premolar and the two first molars,

in order to move a lateral incisor. It consists of a double circle of flat gold which fits the teeth exactly in the same manner as clasps. There is no essential difference between the anchorage part of this appliance and the encapping splint, modified to expose the occlusal surfaces of the teeth and represented, Fig. 6, after R. Duchange. Splints of that kind are, moreover, represented in nearly all textbooks treating on fractured jaws.

There is no place in modern orthodontia for splints as represented in the two preceding figures. In many cases they interfere with the occlusion and possess only, in favourable circumstances, reasonable guaranties of fixity. It would seem rational to abandon them, for the same reasons, as a general rule, in the practise of maxillofacial restoration.

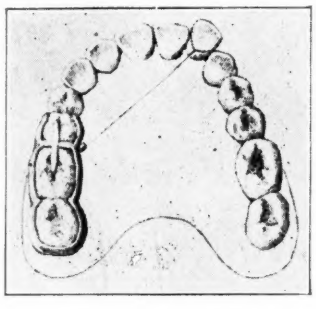

Fig. 5.

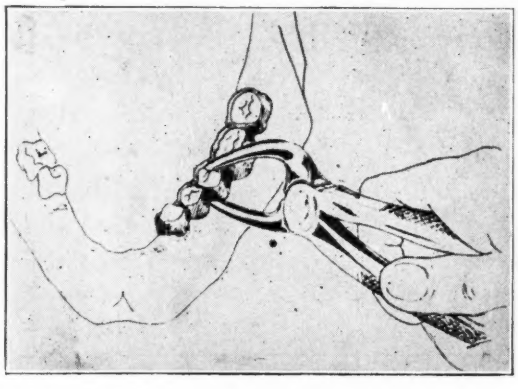

Fig. 6.

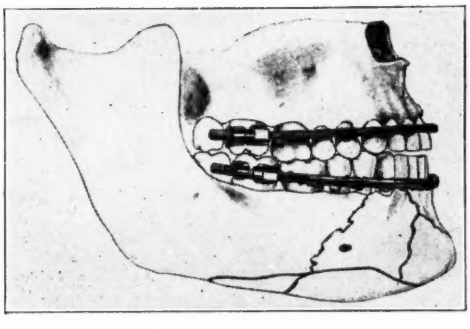

Fig. 7.—(After H. Schroeder.)

Fig. 7 is taken from a study of Schroeder (Berlin) on fractured jaws[5] and represents two heavy alignment arches used for that purpose. Here, we have to do with a modern regulating apparatus. No doubt that, if these alignment arches are used in favorable conditions, excellent results can be obtained.

There are, however, serious objections to the use of alignment arches in the treatment of fractured jaws. The fixation of the fragments corresponds, in recent cases, with the placement of a retaining appliance in orthodontia. It seems, a priori, more rational to use, in these cases, appliances of the type of the retaining devices of orthodontia rather than active apparatus for moving teeth. Lukens bands are used here as means of anchorage. If the use of

such bands is not devoid of inconveniences in active regulating appliances, it is much more objectionable for retaining purposes. Moreover the metal ligatures used here for the retention of the fragments are not good means of fixation and are very rarely used, in orthodontia, for retention.

The bands of Lukens and metal ligatures operate with the greatest advantage in mouths where all the teeth, or at least a great number of them, are present. When teeth are missing, there is a limit from which, by reason of their lacking, no fixation of the fragments could be expected from clamp bands and metal ligatures.

Fig. 8 represents an orthodontic retaining apparatus. It is taken from

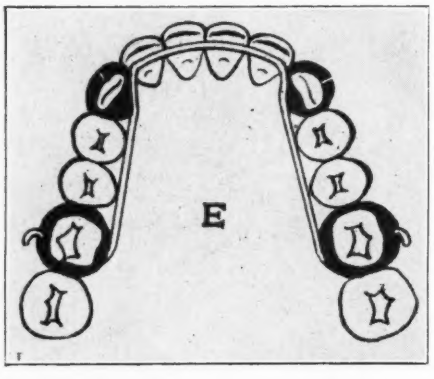

Fig. 8.—(From H. A. Pullen.)

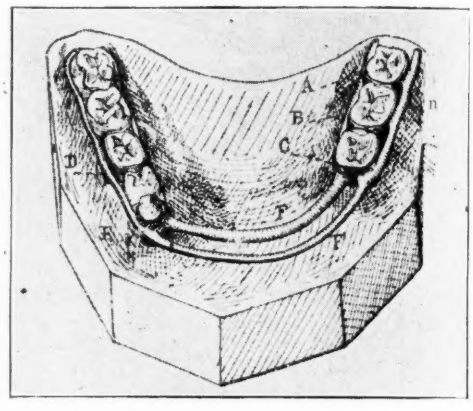

Fig. 9.—(After L. Imbert and P. Réal.)

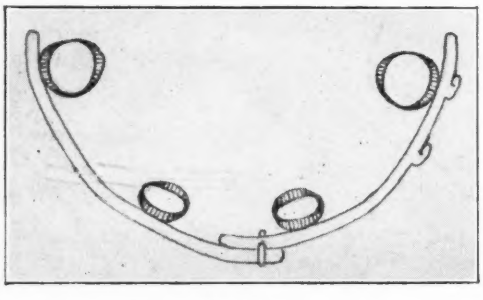

Fig. 10.

Pullen's *Orthodontia* in the second edition of C. N. Johnson's *Textbook of Operative Dentistry*.[6] Fig. 9 shows an apparatus for the treatment of fractured jaws, published in Imbert and Réal's book on fractures of the lower jaw, published in 1917.[7] In the first apparatus, four bands have to be placed at once in the mouth, in the second five bands have to be placed at once upon two fragments of a fractured jaw. Fig. 9 has disappeared in the subsequent editions of Pullen's textbook.

Every orthodontist knows the difficulty, it would be more exact to say the impossibility, of placing such apparatus in the mouth in good conditions. One can safely place and fix at once with cement two bands united by means of a wire arch. The fixation of apparatus with three bands can also be attempted with success. Fixing at once four bands united together seems to be

an intervention of which the durable result could not be guaranteed. If such a difficulty exists in an intact jaw, it is no doubt much greater when two or three bands are situated on one fragment of a fractured jaw and two bands upon another fragment. I think that such retaining appliances as represented by Figs. 8 and 9 are not in accordance with the actual principles of orthodontia and that they cannot be safely used either in orthodontia or in maxillofacial restoration.

II. A SECTIONAL RETAINING APPARATUS FOR TREATMENT OF FRACTURED JAWS

Fig. 10 represents an appliance which I used for a fracture of the mandible, at the height of the symphysis. To the left there is a plain band on the second premolar and one upon the lateral incisor. A thick wire unites these two bands and extends from the lateral incisor, in the mesial direction, to about the middle of the jaw. A hook is soldered at a short distance from the mesial end of the wire and has its concavity looking upwards. This left part of the apparatus has to be introduced first in the mouth and fixed with cement.

To the right the apparatus presents nearly identical dispositions to those existing on the left. There is only one difference. The mesial wire extension does not bear a hook. It corresponds to the hook soldered on the left part and places itself in the concavity of the latter. When the cement of the left part has thoroughly set, the right part is introduced and fixed with cement. After that the reduction of the fractured jaw is made, until the teeth of the two fragments of the mandible correspond as exactly as possible to their antagonists of the maxilla; the hook on the left part of the apparatus is bent upon the mesial wire extension of the right part and both parts are soldered in the mouth with tin or tin solder.

It seems to me that this appliance is in complete accordance with the requirements of modern principles of orthodontia. Only two bands, corresponding to one fragment of the fractured jaw, are placed at once, which gives the best conditions of fixity. Tin soldering in the mouth goes farther than actual orthodontic technics. Attachments could be conceived which would do the same or nearly the same as tin soldering. But as this manner of procedure, made according to the rules of severe technics, does not present the smallest inconvenience for the patient, as it is not a specially difficult operation and as it gives a most firm means of union, I see no objection to its use. In every instance it is only a means of putting into practice, in the treatment of fractured jaws, the result of the experience acquired in orthodontia concerning the placement of retaining apparatus. It allows the fixation, in a most secure manner, of an apparatus including several bands.

The principle of the division of the apparatus in sections, which are placed separately in the mouth and united afterwards when the correctness of their position has been controlled, can be applied to the different kinds of fractures of the jaw and also in some other conditions of maxillofacial restoration. From the point of view of treatment by these means, three kinds of fractures of the jaws can principally be distinguished: (1) Those where each fragment bears teeth; (2) the retrodental fractures of the mandible,

i.e., those where a small fragment, situated in the back of the mouth and including at least a part of the ascending ramus, is toothless; (3) the craniofacial disjunctions, in which the entire face is detached from the skull.

Fractures of the jaws can be recent or ancient. In both cases the retaining apparatus are the same. In recent cases the reduction is easy, in ancient cases interventions may be necessary, which are not within the limits of the object of this paper.

III. TREATMENT OF RECENT FRACTURES OF THE JAWS WHERE EACH FRAGMENT BEARS TEETH

Let us suppose that we have to deal with a simple case, a recent case of fracture in the middle of the mandible.

As the typical appliance above described was intended for such a fracture, the apparatus to be used here does not need to be fully described. In this case, bands were adjusted to the canines instead of the lateral incisors, as canines are more strongly implanted than incisors.

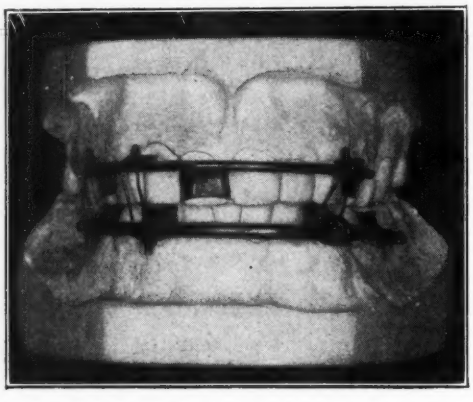

Fig. 11.

Fig. 11 shows how, with such an apparatus, the reduction of the fracture has to be made.

Independent of the appliance fixed to the mandible, I also place a splint on the maxilla. In some cases, this is not absolutely necessary. But its construction requires little time and contributes much to make the results sure and precise. It is formed, like the appliance fixed to the mandible, of bands connected by a thick German silver wire passing on the labial or buccal side of the teeth. I generally fix to these arches a few vertical spurs, which facilitate the application of ligatures. Fig. 11 shows also two spurs attached to the right side of the lower apparatus.

When these appliances are fixed upon the fragments of the mandible and the maxilla, I effect the reduction of the fracture by tying, between both apparatus, brass ligatures 0.40 mm. thick. In this way the occlusion of the teeth of the fractured mandible with those of the intact upper jaw is reestablished. Generally this reduction is operated in a very short time. If it presents difficulties, it may be necessary to repeat the application of the ligatures and, eventually, to let them work during several hours.

When the reduction is obtained and the fractured mandible is kept immovable in good position against the maxilla, I unite the sections of the appliance fixed to the fractured jaw, by soldering them in the patient's mouth with tin solder. Such a soldering can be executed very quickly, with great precision and without any inconvenience for the patient. It only takes a few seconds. When it is finished, I cut the metallic ligatures which have been used for the reduction of the fracture and remove them. From then on, the patient may open and close his mouth and use his teeth for eating.

When the jaw is fractured in more than two fragments bearing teeth, I use appliances formed by several sections. The number of the latter generally corresponds to the number of fragments bearing teeth, which the fractured jaw presents.

Paramedian or lateral fractures.—Fig. 12 shows an apparatus, which was used in a case of fracture of the lower jaw in the region of $\overline{6}|$. It comprehends an external and an internal part. The external part is similar to the apparatus already deseribed and is fixed, with plain bands to $\overline{7}|$, $\overline{2}|$, and $|\overline{3}$.

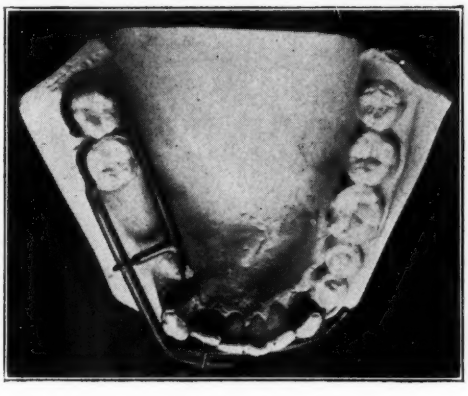

Fig. 12.

The internal part is made of bands on $\overline{8}|$ and $\overline{3}|$ united by means of a thick wire. A rod is soldered to this wire in the region of the second right premolar. It terminates buccally in a hook the concavity of which is directed downwards and which lies upon the external wire of the apparatus. The hook is closed upon this wire and both are united with the aid of tin soldering. The external arch would, no doubt, have been sufficient in this case, but the construction of an apparatus with two arches greatly diminishes the strain which the teeth bearing the external arch have to support in paramedian or lateral fractures, and gives the focus of fracture better conditions for fixity and rest.

Combinations of that kind can also be made in median fractures.

A fractured jaw retained in this manner consolidates in the shortest time possible. The time necessary for healing has of course a certain importance. A point of much greater moment is the greater or smaller perfection with which the organ recovers its anatomic form and its functions. In that respect the apparatus here considered realises nearly all what can be desired, as opportunity exists to place the fragments in the best possible position and to

fix them therein afterwards. The results must be ideal or nearly so in all cases.

It will be interesting to make, upon a concrete case, a comparison between this method of treatment and a few others most generally recommended. An interesting example, Fig. 13, was taken from the recently published book of Duchange, which represents the conditions of a case of fracture of the mandible and the treatment conceived by the author. In this fracture, there are three fragments, a median and two lateral, the two latter bearing each one tooth.

The apparatus used consists of two wires of about 1 mm. diameter, one ligated to the teeth of the maxilla and the other to the teeth of the median fragment of the mandible. A metal ligature going from the upper wire to the lower is intended to operate the reduction of the fracture and keep afterwards the fragments in good position.

The patient is left about ten days in that situation and receives only liquid food. After that time the metal ligature is cut through and the

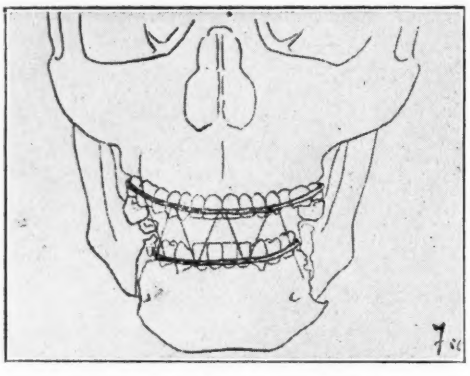

Fig. 13.—(After R. Duchange.)

patient is allowed to open his mouth for a day. Then the mouth is again closed for a week, and then opened. Then "progressively, if the consolidation seems to continue in good condition, the periods of rest are augmented and the periods of closing the mouth shortened."

During all that time the lateral fragments are only prevented by the occlusion of the teeth from obeying the forces which tend to move them inwards and upwards. In the meantime the middle fragment is attracted by the depressing muscles of the mandible, which tend to draw it back and downwards.

In such conditions it can take numerous weeks before the jaw consolidates and it can also happen that it does not consolidate at all. It is also questionable whether the fragments will be in good position. In the meantime the patient has to wait for a much retarded healing and is submitted for numerous days to many discomforts of diet.

Let us now consider the treatment of the same fracture with the aid of complete encapping splints or of encapping splints modified to expose the occlusal surfaces of the teeth. It would be impossible to construct and to fix

in the mouth such a splint, which would at once take hold of the two teeth of the lateral fragments and the teeth of the middle fragment. The only manner to treat such a fracture with an encapping splint would be to close the mouth, a condition which would be, for the preservation of the occlusion, inferior to that obtained with the use of wire arches.

Treating with the orthodontic alignment arch represented in Fig. 1 would do much better. With this it would be possible to take hold of the two teeth of the lateral fragments and to ligate on the same arch the teeth of the median fragment. But this fixation of a fragment by means of ligatures only is not best orthodontic technic and would not be reliable at all, if a small number of teeth would be missing on the median fragment.

If we then take into consideration the retaining appliances of orthodontia, it can be safely admitted that a four band apparatus in one piece, with one band for each lateral fragment and two bands for the median fragment, would not be a good construction in such a case.

Let us now combine a sectional apparatus of the type described above. A section of the apparatus would consist of bands upon $\overline{4}|$ and $|\overline{5}$, united with a wire arch to which would be soldered two hooks and, eventually, spurs. Plain bands, fitted on the molars of the lateral fragments, would be provided, on their buccal side, with wire arches extending mesially far enough to cover about 4 mm. of the wire arch of the median section. An arch with a few spurs, fixed to two, or better to three, teeth of the maxilla, would be placed to facilitate the reduction. The latter would be operated by the means of metal ligatures, then the three sections of the splint would be united together in the mouth with tin solder, after which the ligatures maintaining the mouth closed would be cut through.

It would perhaps be necessary to have the mouth closed during a few days, to counteract the action of the muscles tending to displace the middle fragment back and downwards. After a very short time, the patient could take up again his usual occupations. Consolidation of the fracture would quickly follow, with the most perfect occlusion it is possible to realise.

I could show numerous cases where sectional apparatus of the type of orthodontic retaining appliances have given most perfect results, in the shortest time and with little or no inconvenience for the patients.

IV. APPARATUS WITH SLIDING SPLINTS

Object and general description.—The apparatus just described can only be used in fractures where each fragment bears at least one reasonably firmly implanted tooth. They are not applicable in retrodental fractures of the mandible; i.e., in those where a small fragment, situated in the back of the mouth and including at least a part of the ascending ramus, is toothless. Very often they cannot prevent lateral displacement in fractures where no fragment is edentulous, but where one fragment is large and the other very small.

Many such cases can be treated successfully with closing the mouth of the patient, by one or other means, after having brought the teeth in correct occlusion. It seems, however, preferable, and in certain cases it may be nec-

essary, not to close the mouth and to maintain, as much as possible, the function of mastication during the time necessary to consolidation. Different means have been proposed for that purpose. Fig. 14 reproduces a figure of Blair's *Surgery and Diseases of the Mouth and Jaws.* This author says: "In cases where there is a tendency to lateral displacement, lugs or inclined planes may be placed in splints in various places to engage with the opposing jaw in such a way that, though normal movement of the mandible is not materially interfered with, still the fragments tending to lateral displacement are held in their proper position."

It is evident that the inclined planes of this apparatus cannot prevent the opposed side of the large fragment from coming down and that during the opening of the mouth, this fragment will move to the side of the fracture.

Better combined devices than that reproduced by Blair are to be found in the special literature.

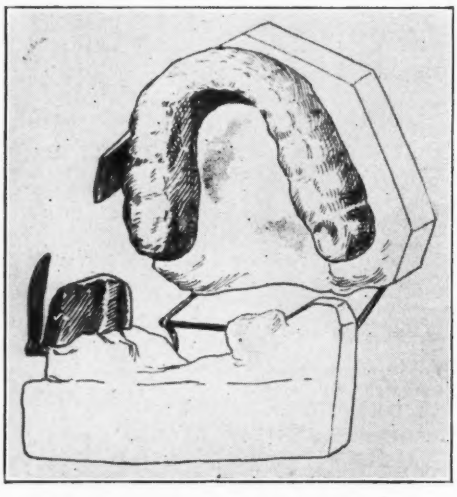

Fig. 14.—(From V. P. Blair.)

Fig. 15 shows an appliance with sliding splint that I constructed for the treatment, with open mouth, of the cases here considered. This appliance obliges the larger fragment of the fractured mandible to follow, during the movements of the opening and the closing of the mouth, very nearly its normal course. When the mouth is closed, the teeth are in their normal relationship with their antagonists. The consequence is that these organs remain well occluded during all the time necessary to the consolidation of the fracture. Thanks to the use of these appliances, the anatomic relationship of the teeth is not only preserved, but their function, which has never been abolished, finds itself, when the fracture is healed, in the very best conditions for complete recovery.

The sliding splints can be used not only for the treatment of certain cases of fracture of the mandible, but also in case of some surgical interventions, as we will see a little later.

The sliding splint is placed on the healthy side. It is made of three plates in German silver, 1.3 mm. thick, the middle one sliding between the

two others. The latter are connected by a German silver strip of the same thickness, soldered to their anterior margin and form a sliding board, applying itself very exactly on the middle plate.

Anchorage of the splint.—In cases where sliding splints are used, the larger fragment of the mandible is drawn, during the movement of opening and closing of the mouth, in the direction of the fractured side, the teeth of this jaw which bear the apparatus have a tendency to be deviated in the buccal direction and those of the maxilla are pressed lingually.

In order to have a good fixation, the apparatus represented in Fig. 15 is attached, by means of bands, on both sides of the jaws: on the maxilla the bands are placed upon $\underline{6}\,|\,\underline{3}\,|\,|\underline{1}$ and $|\underline{2}$ and, on the mandible, they are upon $\underline{6}|\,\underline{3}\,|\,|\underline{3}$ and $|\underline{5}$. The placement of an apparatus including so many bands is rendered possible by its division in right and left sections, which are fixed

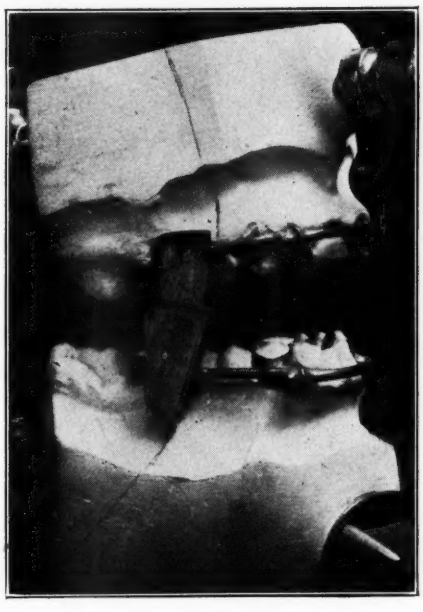

Fig. 15.

in the mouth separately and soldered afterwards by tin solder, mesially of the right canines.

When the force exerted upon the sliding splint is not very great and it seems that the treatment will not be long, simpler means of anchorage may be used, for instance, three or even two bands on each jaw on the healthy side. The teeth best suited for receiving these bands are the first molars, the canines and the lateral incisors, in the cases where three bands are used, and the first molars and canines in the cases where only two bands are used.

Two types of sliding splints.—I use two types of sliding splints: one is intended to prevent the displacement of the large fragment backwards to the side of the line of fracture, the other is intended to prevent the movements forward. The first is nearly always used, as the displacements of the great fragment backwards are nearly the general rule.

The two types of sliding splints differ only one from the other by their manner of being soldered to the remaining part of the apparatus.

Fig. 15 represents a splint intended to prevent the displacement of the larger fragment backwards and in the direction of the fractured side. The sliding board is fixed to the mandible and the median plate is attached to the maxilla.

When the larger fragment is displaced forwards, the sliding board is fixed to the maxilla and the median plate is attached to the mandible. In this manner any forward movement is prevented.

Description of two cases.—I think it interesting to consider especially two cases which were treated with sliding splints of the type described above, in order to show the benefit which can be obtained, from the application of modern orthodontic principles, not only in the treatment of fractured jaws, but also in the surgery of the mandible.

Fig. 16.

Fig. 16 represents a radiogram of a case of fracture, in which the angle and a good part of the body of the mandible, on the right side of the mouth, were separated from the rest of the jaw. The patient came to me the seventh day after the accident, presenting an abundant suppuration of the focus of fracture. On the small right fragment there was only one tooth present, the $\overline{8}|$. On the large fragment were existing $\overline{5\ 4\ 3\ 2\ 1\ |\ 1\ 2\ 3\ 4\ 5}$. An apparatus was made consisting of two parts, one of which was a plain band upon $\overline{8}|$, on which was fixed a thick wire. This part was soldered in the mouth with tin solder to the other part of the apparatus, fixed upon the large fragment. A sliding splint, placed on the left side of the mouth, prevented displacement of the large fragment.

Sequestra were eliminated during several weeks and the whole consolidation of the jaw took six months. For a long time an abundant suppuration persisted, and the elimination of the great piece of bone lying free in the focus of fracture was a threatening eventuality. If this piece had been eliminated under the form of a sequestrum, the apparatus fixed in the mouth could have stood several months. Then a bone graft could have been made and,

after the success of this operation, the patient would have recovered his jaw in the occlusion it had before the accident.

We can imagine now that, instead of having a free piece of bone in a focus of fracture, we would have a tumor rendering necessary the removal of a section of bone of the whole height of the mandible. In such a case an apparatus with sliding splint, of the type here presented, could be constructed and placed before the operation, the removal of the diseased bone could then be undertaken, without any damage of the occlusion of the teeth. A few days after the operation, the patient could return to his ordinary occupations, such appliances needing no more control when correctly constructed than an ordinary retaining regulating appliance. At the time fixed by the surgeon, several weeks or months later, a bone graft could be made, the appliance being an ideal one to favor the success of bone transplantation in the jaws.

Fig. 17.

Fig. 17 shows the radiogram of a case of multilocular cyst on the jaws of a lady thirty-six years old. The tumor had destroyed nearly the whole right ascending ramus and a good part of the body of the mandible at that side. An operative intervention was formally indicated.

An apparatus with sliding splint was placed on November 7, 1921, and on November 9 the extirpation of the tumor was made by Dr. Hil. Brohée of Brussels. The destruction by the tumor was of such an extent that all the remaining bone of the invaded region had to be removed during the operation. From the whole ascending ramus, only the condyle could be left. A little more than the back third of the right part of the body of the mandible disappeared during the intervention.

The patient remained in that state, having still her apparatus with sliding splint in position, during more than one year and a half and preserved fairly well the former occlusion of her teeth. On June 23, 1923, an osteoperiostic

bone graft was made by Dr. Hil. Brohée, according to the method of Delagenière. The surgeon attempted to build up again the lost part of the body of the mandible and of the ascending ramus. This operation succeeded. Three months later the appliances were removed, the teeth having fairly well preserved the occlusion they had before the operation.

It is not the place here to compare the action of the sliding splint presented with that of other types of this kind of appliance. From the orthodontic point of view, the most distinguishing feature of the sliding splints used in the preceding cases consists in the fixation of the apparatus with the aid of plain bands, in a number as large as the case can require and with the best conditions of fixity. This is rendered possible by the division of the apparatus in sections, which are introduced in the mouth separately and soldered afterwards with tin.

This security of fixation, in accordance with the most approved practise of modern orthodontia, together with the special features of the sliding splint, allows the preservation of a perfect occlusion of the teeth, even after loss or surgical removal of large pieces of bone. Patients wearing such appliances are not to be considered as being ill, but they can continue their lives as active members of the community and recover, even after many months, the integrity of their masticatory apparatus.

The sliding splint and the reduction of the fracture.—I think it is necessary to make the important remark that sliding splints can be used with success only in cases where it is possible to make the reduction of the fragments of the mandible without any difficulty. If this would not be so, the case must receive firstly a treatment which gives the required mobility to the fragments.

V. RECENT CRANIOFACIAL DISJUNCTIONS

The principles of retention followed in the fractures which we have considered are not applicable to the craniofacial disjunctions.

In these fractures, the apparatus are constructed in order to have the detached face supported by the skull. They consist, as a general rule, of a splint fixed in the mouth and a cranial cap, united by elastics or by other means. The buccal splint is provided with metallic arms, which come out of the mouth a little before the commissures, turn around these latter and are directed backwards, at a short distance from the cheeks. The buccal splint and the arms fixed to it form a unique appliance, which has to be introduced at once in the mouth.

I have modified these apparatus according to the principles of construction previously described. The following example illustrates this manner of proceeding.

The patient was kicked by a horse in the region of the root of the nose. This caused a craniofacial disjunction, and fractured moreover the maxilla behind the left canine.

Fig. 18 shows the part of the apparatus which was fixed to the teeth. Instead of being formed by a single piece, it is made of four sections. Two of these are formed from bands to which is attached a thick wire and bear externally a metallic tube about 15 mm. long. The two other sections are arms

destined to unite the intrabuccal apparatus to the cranial cap. At this moment they are slipped in the tubes and are not soldered.

The two right sections of the apparatus are first introduced in the mouth and then the left sections, in order to determine, by this first trial, the best place for the arms coming out of the mouth. These may in no manner inconvenience the buccal commissures. When their best position has been found, the apparatus is taken out of the mouth and the arms are soldered, with tin, to the tubes in which they are slipped.

Fig. 18.

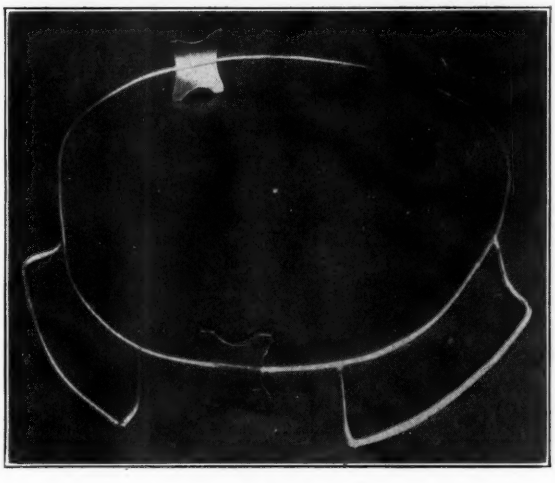

Fig. 19.

From that moment there are only two sections of the apparatus, which are introduced in the mouth and fixed with cement. After placing all parts in good position, these two sections are soldered together with tin, in the manner previously described.

The cranial cap is made of plastered bands and contains a metallic frame (Fig. 19). A German silver wire 3 mm. thick is bent around the transverse circumference of the head, at the height of the forehead, and is provided with three metallic plates. Two wire arms are attached on each side, from the region of the ear up to 3 to 4 cm. from the middle line. Their horizontal part must stay out of the plastered bands.

Before applying the plastered cap, the hair is cut very short or the head shaved and the latter coated with a thin layer of vaseline. The plastered band is firstly wound two or three times around the head, then the metallic frame is placed and the application of the plastered band is continued. A few thicknesses of plastered band are passed transversely over the summit of the cranium. A few windings of a flannel band may precede the application of the plastered bands.

A similar cap has been described by Chr. Bruhn.[8]

When the cranial cap is finished, it has still to be united to the apparatus fixed in the mouth. I use, on each side, a German silver stem which I solder with tin, to the arms coming out of the mouth, and to the wire arch coming

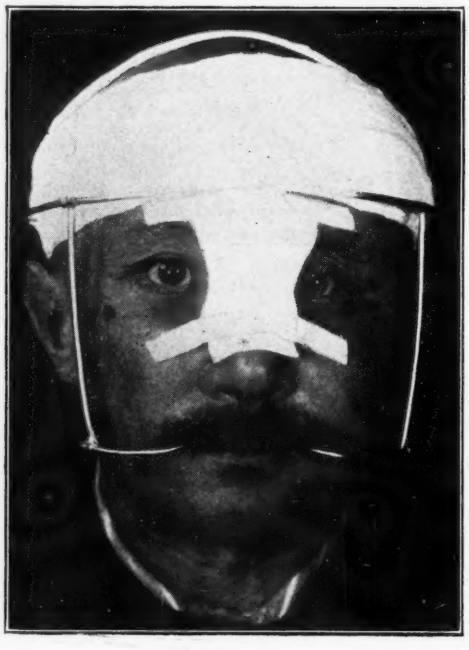

Fig. 20.

out of the cap. Fig. 20 shows that this soldering is made by the means of small, curved plates soldered to the extremities of the metallic stems.

VI. TECHNICS

Band making.—The bands used as a means of anchorage upon the teeth are the plain bands used in orthodontia.

The question of fixity of plain bands attached upon molars has been the object of much discussion in recent years. It is generally admitted that such bands have a tendency to come off. It is easy to understand that it must be so, if no special measures are taken, if one considers the length of the circumference of molar teeth on different heights.

Fig. 21 gives the result of measurements of three mandibular molars. The first line gives the length of the circumference near the occluding surface, the second line gives this length taken at the height of the contact

points, the third line gives the length of the circumference at about 4.5 mm. of the occluding surface and the fourth line gives the length of the circumference at the height of the neck of the teeth.

The measurement of the circumference of maxillary first molars, at different heights, gives nearly the same results. It is materially impossible to adapt perfectly metallic bands upon bodies having the shape of first molars.

Consideration of a mandibular first molar shows that the conditions of adaptation of a metallic band are especially bad in the gingival part of the lingual surface, where exists a notable depression. There is great danger that a force acting lingually upon the occlusal border of the band, brings down the band on that side. In order to remedy this inconvenience and to improve the adaptation of the bands of mandibular first molars, especially in the gingival part of the lingual surface, I solder on the inside of these bands, near the gingival margin, a strip of metal 7 to 8 mm. long, 0.2 mm. thick, and 1.5 mm. high. Adjusted bands, reinforced in this manner, take a strong hold of the teeth and, as a rule, a rather great effort is necessary to detach them, even in absence of fixation by cement.

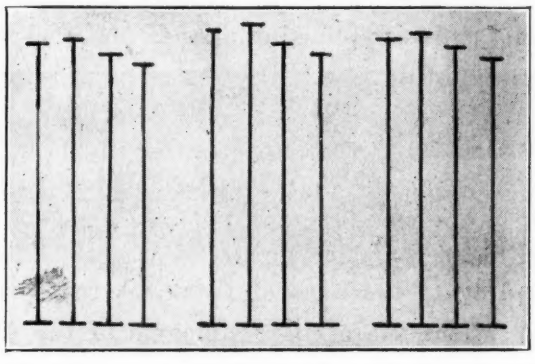

Fig. 21.

Examination of maxillary first molars shows that the conditions of adaptation of metallic bands are especially bad, not on the lingual surface, but in the gingival part of the buccal surface. In order to remedy this inconvenience, I solder, *on the buccal side,* to the inside of these bands, near the gingival margin, a strip of metal having the same dimensions as that described for the mandibular molar bands. Maxillary molar bands reinforced in this manner, present the best conditions of fixity.

It is strongly recommended to reinforce, in the described manner, all first molar bands, when the mobility of the fragments of the fractured jaw does not prevent the use of the force necessary to the placement of such bands.

Making of a splint with external arch.—The bands being in position, plaster impressions are taken and models are poured in investment material. If it is not possible to take at once the impression of the whole fractured jaw, two or even more partial impressions are to be taken. The model or models obtained with the aid of these impressions are cut through at the height of the lines of fracture, the partial models obtained in this manner are brought together and disposed in good occlusion with the model of the intact jaw.

A unique model is made of them, as it is the rule in the making of most splints for fractured jaws. In these reassemblages I guide myself especially by the position which the teeth of the fractured jaw take in the mouth when they are placed in their natural contact with their antagonists. Metallic ligatures, attached to a tooth of each fragment, may frequently greatly help to obtain such a contact.

An exact reassemblage of the fractured jaw being obtained, I pass to the making of the appliance. I use German silver wires of 2.5 mm. thickness in the parts before the lines of fracture, of 2 mm. between the bands in other parts of the appliance, of 1.3 mm. for the spurs and of 1 mm. for the hooks. Platinum gold wires of smaller gauge can, of course, be used. Wires of the desired length and thickness are adjusted, then fixed to the bands with adhesive wax. A distance of 1 to 2 mm. is left at best between the teeth and the part of the appliance on which it is intended to do a tin soldering. The hooks are best placed, not upon the bands, but at the distance from them which the case allows. In order to facilitate the investing and the subsequent soldering, I bend only slightly, at this moment, the wires destined to form the hooks. These wires and the spurs are, for the same purpose, left 1 cm. longer than they have to be in the completed appliance.

All the parts being adjusted and fixed, they are imbedded in investment compound. The wires corresponding to the lines of fracture must not be surrounded by the investment material, but must only form in the latter a groove out of which they can be taken. Before warming the model for soldering, the wax is melted, these wires are taken out and laid aside. This manner of proceeding greatly facilitates the soldering of the hooks. These being soldered, the wires corresponding to the lines of fracture are replaced and soldered.

There are cases where one of the fragments of the fractured jaw, situated posteriorly, bears only one or two teeth and where the data for the exact reassemblage of the model are insufficient. The part of the splint destined to the large fragment may then be constructed first and fixed in the mouth. The band or bands of the small fragment are then put into place and plaster is poured on the latter and, from there, on the parts of the large fragment of the appliance, the moulding of which may be useful. The fractured jaw is placed in good occlusion and the plaster allowed to harden. In this way, a model is obtained with which it is possible to finish the splint with complete sureness.

Placing of a splint with external arch.—The finished appliance is firstly tried. Corrections are eventually made to it; then it is sealed in the mouth. By constructing the appliance with care, corrections can generally be avoided.

The order of introduction and of fixation of the different parts of the appliance is given by its mode of construction. As soon as one part is placed, the patient closes his mouth in order that the operator may verify its position. One must take care, while the cement is still soft and slight changes in position are possible, that each part corresponds exactly with the part to which it must be soldered with tin. Extreme care is necessary here, as a slight movement may compromise the fixation of the appliance.

Tin soldering.—Such a soldering may and must be executed in the mouth with very great precision and rapidity and *will not cause the smallest inconvenience to the patient.* The operator must strive here to strictly follow the rules of rigorous technics.

The parts to be united must be situated, as much as possible, in the anterior part of the mouth, as such a position greatly facilitates the work. By taking the necessary precautions to keep the cheeks well away, one may, however, solder as far as the first and even the second premolar. First, all the parts which are to be soldered with tin are to be tinned before the apparatus is placed in the mouth. Certain tin pastes which are on the market may be valuable here. It is very advantageous, in case of splints with external arch, to have, at the point where the soldering must be made, two wires juxtaposed on a length of 4 to 5 mm. The superior border of the anterior wire must be situated a little lower than that of the wire placed behind it. The latter can, in this manner, be sufficiently warmed for the attachment of the tin. The hook or the hooks, opened at the time of the placing of the appliance, must be closed, without exerting any pressure upon the wire that they surround. The parts which have to be soldered must be exactly in con-

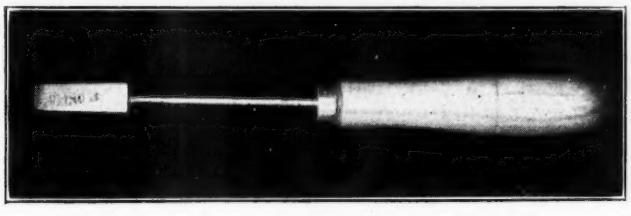

Fig. 22.

tact with each other. I keep the saliva away by means of cotton wool and protect, in the neighbourhood of the parts to be soldered, the gingiva and the teeth with asbestos paper. It is in order to facilitate this measure of precaution that I recommend to leave a distance of at least 1 to 2 mm. between the teeth and the parts of the appliance on which it is intended to do a tin soldering. The surfaces are dried, then moistened with zinc chloride. The latter is obtained by plunging successively small bits of zinc in hydrochloric acid, until there is no more effervescence. The product is then filtered.

I use a straight soldering iron, of appropriate size (Fig. 22). The instrument represented in Fig. 22 is 21 cm. long. The soldering iron must be as clean as possible and suitably warmed. The temperature must be a little higher than it is necessary to melt small bits of tin and to make them adhere to the instrument. Every time the soldering iron is passed in the flame, it must be rubbed on a piece of hydrochlorate of ammonia before being applied on the tin. The soldering comprises two periods: in the first, a fusing bit of tin, attached to the soldering iron, is carried to the place where the junction is to be made and laid down there; in the second, the soldering iron is warmed again, rubbed on the hydrochlorate of ammonia and brought in contact with the tin already placed; the latter is melted and flows on and

between the parts which have to be united. These two periods last each only a few seconds.

In case it seemed desirable to undo a tin soldering, one may proceed in the following manner: With a small round engine bur, the hook is freed and the layer of soldering which unites the wires is thinned down. Ordinarily pliers can then detach the hook and a forceps for cutting roots, *gently* inserted between the wires, separates one from the other. If one wishes to make a new soldering in the same place, the superficial layer of the remaining tin is first removed with a grinding stone.

Making of an appliance with sliding splint.—When the bands are finished and set on the teeth, plaster impressions of the mouth are taken, the alveolar process on the sound side being carefully included as high as possible. The bands are set in their place in the impression and models are made in investment compound. These are fixed in their natural relationship. The precise restoration of the occlusion is much more important here than in cases where each fragment bears teeth. A slight error in the relationship between the models may lead to defects in the construction, the correction of which demands a considerable amount of time.

I am accustomed to mount the models on a Gysi Simplex articulator, following the rules prescribed for the use of this instrument.

The best place for a sliding splint corresponds to the second premolars and the first molars. The surfaces of the plates entering in their composition slide there better one against the other than in a more forward position. Furthermore the angle of opening of the mouth is smaller in the region of the second premolar and the first molar than more forward. Consequently a sliding splint can be made shorter in the former than in the latter.

In order to determine the place for the sliding splint, I take a pair of compasses and describe, upon the plaster models, an arc of a circle in the region of the second premolars, taking as center the axis of rotation of the movement of opening and closing of the articulator. After that one draws the same arc upon a sheet of paper. The line obtained gives the curve for the anterior borders of the plates entering into the composition of the sliding splints.

The plates of the sliding boards are 1.3 mm. thick; they must be quite even, in order that their surfaces may fit exactly, one against the other. The fixation of the median plate to the remaining part of the apparatus is made by means of soldering. In order to have room for this soldering, about 3 mm. in the width and 6 mm. in the height are sawed off, posteriorly, from the internal plate.

The two types of sliding splints comprise each three identical plates and differ only from each other by the way in which they are attached to the remainder of the appliance. The plate that connects on their anterior border is as thick as the two plates forming the sliding board. It is well to have these pieces prepared beforehand, the anterior border of the plates describing an arc of a circle of medium curvature. In order to use these plates in a special case, it is sufficient to adjust their anterior border and to diminish

sufficiently at the back the internal plate of the sliding board to allow the attachment of the middle plate to the remainder of the appliance. The constitutive parts of the sliding board are then united with solder.

By means of adhesive wax, German silver wires, about 2 mm. thick, are attached on the superior model and on the inferior model, where their placing is indicated.

In order that the plates entering in the composition of the sliding splint may slide one against the other, during the whole movement of opening and closing of the mouth, it is necessary that their direction approaches from that of the sagittal plane. Practically, however, there is no inconvenience if the sliding board instead of being exactly set in that direction, should be directed very slightly from behind forwards and from outwards inwards. In this position it is less obstructing, though it leaves still a good contact to the surfaces.

The sliding splint is now fixed to the remaining part of the apparatus by means of adhesive wax. It works best when, during the movements of opening and closing, the sliding board is applied steadily against the anterior border of the middle plate. It is then that the course followed by the great fragment corresponds most nearly to its normal course. In order to find the best position of the sliding splint, the plaster models mounted on the articulator are made to execute movements of opening and closing. Several trials are generally necessary before obtaining this position.

Now, all parts constituting the appliance have been carefully prepared, keeping an account of their future function and of the forces which will act upon them and upon the teeth which will bear them. They are connected to each other by means of adhesive wax. After a last control, the articulator is opened as far as possible, care being taken that the relationship between the sliding board and the middle plate is correctly maintained; the models are detached, the different parts are placed in investment material and those which must be soldered are united with silver solder.

Placing of an appliance with sliding splint.—The fixing in the mouth of the appliance requires some special precautions. It is of great importance that the teeth on which the bands will be set should have been well separated from their neighbours, so that the introduction of the appliance does not meet any difficulties. The apparatus is first placed in the mouth for trial. If it has been well constructed, the sliding splint must, when the mouth is closed, occupy the same place as on the articulator.

Once the appliance has been tried and found correct, it is placed in the mouth without cement. The part which bears the sliding board is first taken out and the other is left in place. The first one is dried, as well as the teeth which must support it, and it is fixed with cement. This placing is effected most easily when the mouth can be opened enough to introduce this part of the appliance without meeting the one that is attached on the other jaw. The mouth is then closed and I make sure that all the parts of the appliance are in good position. When the cement has hardened, the part of the appliance that bears the middle plate is taken out and fixed with cement.

CONCLUSIONS

The appliances for the treatment of fractured jaws, recommended by the most approved textbooks of today, are essentially orthodontic apparatus. Most types of these appliances have been abandoned for many years in the practice of orthodontia. Others are lacking in conformity to the modern principles of practice of this specialty.

It is possible, in the treatment of fractured jaws and in other cases of maxillofacial restoration, to construct appliances which completely conform to these principles.

The aim of orthodontia is to place the teeth in the most ideal relations as conditions present allow. The aim of maxillofacial restoration must not be placed lower than that of orthodontia and must tend to place the jaws in the most ideal relations as conditions present allow.

If today orthodontia can attain the brilliant achievements of which it may be proud, this is greatly due to improvement of technic. Devices have been imagined presenting conditions of fixity and provision for application of force which allow the realization of results approaching more and more to the ideal. In order to attain the best in the reestablishment of anatomic shape and function, maxillofacial restoration must avail itself of every advancement in orthodontia, the branch of which it has borrowed in the past the best of its resources. This must in no way impede it to promote progress itself. In the present state of advancement, the treatment of fractured jaws and the mechanical treatment of many other cases of maxillofacial restoration are most closely allied to orthodontia. The orthodontist is the best qualified specialist in stomatology to practise this branch successfully.

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DISCUSSION

Dr. Jos. D. Eby.—It is indeed a personal privilege to have the honor of discussing Dr. Rubbrecht's paper. I feel a sense of gratitude in the fact that a paper of this nature will take its place in the records of the First International Orthodontic Congress. This is a very important subject, and embodies a phase of orthodontia which is held in too slight general regard. I am sure it could not be presented from a better source than through the rich experience and able mind of our essayist.

Orthodontia in this sense may be more appropriately termed *dental orthopedics.* This

phase of our science occupies the same relation of oral surgery that orthopedics bears to general surgery. Dental orthopedics owes a great deal to maxillofacial surgery, and likewise maxillofacial surgery owes a great deal of recognition to dental orthopedics. We are living in an age wherein injuries to the face and jaws are becoming more and more prevalent, and so far as my experience has gone, I have found no one as well equipped as the orthodontist for the production of proper mechanical apparatus for the immobilization of fractures, and other mechanical contrivances essential to the best results.

To one whose experience is gathered from a more remote source; i.e., from similar activities in the United States, the most impressive phase of his paper lies in the similarity of methods of treatment and designs of apparatus which have been found to be most effective. This illustrates how rapidly ideas will travel, and how under certain conditions the best principles of treatment will be recognized and followed effectively.

I wish to depart from the general trend of the subject sufficiently long to make an observation which I believe to be analogous in the practice of orthodontia, and to cite a conclusion which should have its effect in the modern progress of orthodontia. When the great crush of maxillofacial wounds piled into the general hospitals, practically overwhelming the men engaged in their treatment in all countries, there was no time for the lengthy pursuit of ineffective hobbies, or for any elaborate play on the parts of men, who, as individual geniuses were attempting to develop intricate mechanical creations. Very rapidly this work was forced, under conditions, to settle down to the task of assured and effective production of results, which stood for themselves as above question, or gave evidence against other ineffective methods, at the same time demonstrating whether or not the individual operators had the proper vision and preparation for their tasks.

In orthodontia, which of course is much more greatly diffused, and operated under a much more independent position of the individual, we have, none the less, a basic sense of responsibility to the patient and the evidence of the effectiveness of our results. Still, however, our specialty, none too well entrenched scientifically, is beset constantly by men, who, in the pursuit of hobbies or in the tenacious endeavor to force the survival of methods of treatment which are unfounded in the knowledge of the manipulation of vital tissue, continue to obstruct progress. The fact remains that evolution in orthodontia is taking the same course which was rapidly forced in maxillofacial orthopedics; i.e., to recognize that the applied therapy expressed in terms of mechanical apparatus must be definitely prescribed for the individual case and must recognize certain basic principles, regardless of the design of the appliance or who makes it.

A second most impressive thought which comes to my mind from Dr. Rubbrecht's paper is the emphatic demonstration that all the principles which he has suggested, and the illustrations which he has shown have taken deep thought to produce the designs of the appliances. The first great truth which his work recognizes is the necessity for secure anchorage, and the second relates to simplicity of design. In direct comparison it will be found that the more ineffective methods of treatment are usual insecure, elaborate creations, originating more in attempts at mechanical ingenuity rather than regard for principle. It seems to be quite unnecessary to present any additional illustrations to verify those of Dr. Rubbrecht's in establishing the fact that this work is primarily a part of the science of orthodontia. Literature is replete with this material, and it is readily available to those who are interested. It is my opinion that every orthodontist should not only be interested, but should feel a point of personal pride in being equipped to intelligently treat this work as a definite part of our specialty.

In recognition of the great service which Dr. Rubbrecht and his colleagues have performed in this field, I wish to acknowledge the contribution which their early efforts made in the stabilization of the proper methods of treatment of maxillofacial injuries, and the fact that the methods employed successfully in the United States may have their origin traced to them.

Dr. Rubbrecht.—I should like to express my thanks to Dr. Eby for the kind appreciation of my work. What I intended to make clear was that we cannot in the treatment of fractured jaws use the orthodontic methods recommended in old textbooks and that we must use such apparatus as is in best accordance with our modern practice. Modern orthodontia does not understand systematizing treatment as it was done a few years ago.

We should now use only the appliances which can give us the best result and in using any of them, we must use them according to general principles.

I am very glad to have heard Dr. Eby, one of the most eminent men of America, and who furnished some of the best work during the war. I am glad to know that he understands these principles exactly as Simon and I do.

ENDOCRINODONTIA

Lectures Read Before the Dewey Study Club

By Dr. David M. Kaplan, New York City

Lecture VI

NOW that we acknowledge that the endocrines have a determining power in the somatic and psychic trend or tropism of an individual, we may proceed further. To recapitulate the endocrine tropisms: The pituitary rules over the bulk and rhythm of man and woman; the thyroid over equilibrium and quality; the adrenals over energy and masculine decoration.

In the early stages of any vicious trend the endocrines, by proper handling, may be checked and detoured back to normalcy. But when histopathologic changes are present, very little can be promised. A favorable prognosis by the inexperienced only serves as a check to endocrine progress. In this lecture an interpretation of endocrine phenomena which occur in the gonadotrope will be dwelt upon. It will include the functional and subjective manifestations, interspersed here and there with histopathologic confirmation of endocrine findings still in a state reactive to medical interference. Various therapeutic precepts will be offered, which in the main may not tally with orthodox opinions. Such only will be adduced which have given complete satisfaction and lasting relief.

That the preservation of the race depends upon the integrity of the gonads is almost axiomatic. If the ego is to survive in the form of another individual, it is so insured through the activity of the reproductive organs. Hereditary characteristics, and the varied nuances of character, predisposition, and personality, in fact, the entire kaleidoscope of soma and psyche are embodied in the spermatozoon and ovum. They are, ab initio, stamped with the determinant and dominant peculiarities of their parental host. The union of the two elements reciprocally complement each other in that the male's recessive features are supplemented by the female's progressive equipment, and vice versa.

The factors, somatic and psychic, which are necessary to make a complete male or female, are unknown, and the summum bonum of perfection,

and what is best for mankind, only the future will disclose. I wish God-speed and good luck to the eugenists.

I make the statement that there is no man or woman without heterosexual psychic or somatic appanages, no matter how perfect their architecture may be. Similar to the bipolarity of the magnet, every human being is likewise bisexual. In the study of gonadotropisms the quantitative determination of the heterosexual content will have to be ascertained prior to the therapeutic advice given. This is only possible with an adequate knowledge of endocrine principles and facts, and the ability to collate apparently dissimilar findings.

Not so very long ago the fact that mumps was often followed by an orchitis gave no food for thought to medical men of those days. The endocrinologist of today knows very well that mumps is a juvenile expression of gonadotropism, just as diphtheria is of adenotropism or measles of thyrotropism. The tropic fabric in the future will be strengthened by many strands which will enable the doctor to detect with comparative ease the trend of a discomfort and by treatment forestall incurable static changes.

As emphasized before, prophylaxis is the chief domain of endocrinology, and the results of its proper application will reflect upon the soma and psyche of future generations. We will be able to compel the pituitary to help the female, and curb this gland, in its endeavor to emasculate the male. We will be successful in thwarting the overactive adrenals in the female, and prevent moustache hirsutes, and beards where such a decoration is out of place. With it will follow a more rational masculine and feminine psyche, making the home happier and social burdens lighter.

If it were possible to ascertain the history of the infancy of such psychopaths as Marquis de Sade, Zacher Masoch, Oscar Wilde, and Harry Thaw, I am fairly certain that they would have disclosed an attack of mumps during that period, and timely treatment would have kept them out of the limelight of undesirable notoriety. The endocrine factors of criminology are preeminently the gonads, reflecting a psychopathic heredity, together with mumps and environment.

How often does a bad egg return to the fold, a penitent prodigal son, having emptied his seed bag of wild oats, and enters the field of reform. And why, I ask you? He entered the gonadopause. His urge is gone, his stock of mischief is spent; he is harmless enough to become a preacher, and he becomes one. In his lonesome hours, alone, or in his dreams, he reiterates, but gets no support or ammunition from his gonadal arsenal. He is a sort of Deus-e-machina, or a politico-social example of the homeopathic principle of similia-similibus; evil curing evil. He is hungry for love, admiration, regard, and having none of his youthful vigor and glory, attempts to hoodwink the masses and ensnare them with his pictures of heaven and hell. A veritable devil, quoting the Bible to gain his ends. Some become tent preachers, others institute vice crusades or become censors of literature and art. All, like the dog in the manger, so long as they cannot eat the fodder, at least no one else shall have it; misery likes company.

These activities are the subconscious display of gonadotropism, on a

waning plane, and their endocrine characteristics give the clue to the territory or root of the trouble.

The pure saint is a possibility, provided, ab initio, the gonads are dumb and physically as well as psychically lethargic. Mumps must fall upon a soil hereditarily below par and gonado-tropically indexed, in order to produce a disturbance in the cerebro-adrenal mechanism.

In order to function correctly, the gonads require the healthy support of the other endocrines, including the judgment-capacity inherent in the cerebral mechanism, and only when this orchestration is perfect can we speak safely of a mens sana in corpore sano.

All this is necessary to know before designating not only the tropism, but also the social trend of the individual. The diseases of infancy, the gonado advent, the home life, hereditary traits and environment enter into such an analysis. It seems that the taboo of discussing the vita sexualis has not been removed, and patients very reluctantly indeed can be made to dwell upon this subject. Their demeanor in such instances displays a certain secretiveness, as though their innermost self is about to be placed under a microscope. This is to be carefully noted, and by roundabout detours the doctor gradually arrives at the correct conclusion.

Periodic headaches, attacks resembling epilepsy, loss of appetite, peculiar dreams, bagginess under the eyes, and a bashful, furtive look, as if their secret is about to be advertised to the world. In sizing up your patient, if she is a woman, it is imperative to obtain a complete picture of the periodic flux. Most gynecologists are satisfied with periodicity, duration, amount and degree of discomfort. To the endocrinologist this is not enough. He must know if the napkins are washable, he must determine the location of the menstrual blemish. Few doctors pay any attention to this physical sign of menstruation. At the same time it is a very important clue to the completeness of the gonadal expression of the woman. This sign appears a few days before, or on the same day with the flow, and consists of a small pimple, reddish to start with, enlarges, and more often than not containing a small amount of pus. It is located in the normal woman on the upper lip, near the nasolabial sulcus, on the right or left side. At times it may appear on the chin. Should this blemish appear on the cheek, forehead, or chest, or back, it bespeaks a slight gonadal abnormality, and is one of the gonadotropic indices of the individual. Such pimples are quite often to be observed in boys, in crops over the face and body, and are nothing more than an expression of overcharged gonadal secretion. Such boys are foolishly advised to seek illicit relief, with dire consequences to the soma and psyche, not at all being a rarity. The best procedure is to wait for the endocrines to establish an equilibrium, and if it does not follow, then you know by this time what to prescribe. It is important at all times to bear in mind the secret partnership between the gonads and the thyroid in females. The parent who is old-fashioned enough not to acquaint, in guarded terms, the pubescent daughter of her place in nature will have to pay doctor's bills sooner or later to overcome the shock that the thyroid sustained by the first surprise of menstruation.

The first gonadal crisis must be anticipated by proper instruction and by motherly solicitude, coupled with the common sense of experience to take this seeming curse as a necessary evil. The health of budding womanhood is in miniature what it will be later, and unless skillfully and lovingly sponsored, a slight twist now will be magnified in a serious somatic or psychic catastrophe.

The boy's first gonadal crisis also has its terrors. He broods silently, blushes in the presence of girls, becomes absent minded, forgets his lessons, he cannot concentrate, and receives the coup d'etat when he fails in his examinations. At the age of fourteen or fifteen every father's duty is to become the pal and chum of his son. Don't forget that if you don't tell him where he stands in the order of nature someone much less concerned about his soma and psyche will tell, and give him advice to which you will by no means subscribe. The overrespectable, prudish father is not infrequently responsible for his son's delinquency, who may become a ne'er do well, or an outspoken criminal. We may have good, bad, or indifferent remedies for such unfortunates, but the best is proper preparation, which works as an admirable prophylactic. If the latter were a universally accepted practice, legislators, lawyers and doctors would be spared much unpleasant work.

I shall now endeavor to point out the importance of dental endocrine analysis, in order to ascertain this tropism of an individual. To recapitulate, the upper middle incisors carry the endocrine message from the pituitary; the canines do the same from the adrenals and the upper laterals serve as an index to the functional and even somatic integrity of the gonads, male or female. And strange to say, the relationship is a crossed one, in that the left lateral points to the right testis, or ovary, and the right lateral to the corresponding organ on the left side. Why this is so, no one was able to ascertain, but you will find that it works out in the majority of instances.

The dental index consists often in no more than a slight deviation from the normal, in that the tooth, compared with the rest of the teeth, is stunted in growth, or shows an implant defect, the anterior edge overlapping the middle incisor, or a slant of the lower border. These abnormalities must not be a part of a general malformation of the upper jaw.

A few illustrations will fix this tropic index in your minds. I had occasion to visit the hospital where I spent the first eight years of my medical training, and was invited to give some of my views upon endocrinology. Among other things spoken of in general were the gonadal endocrine tropisms. I ventured to remark that one could determine a cryptorchitis without an inguinal examination. Thereupon I was challenged to prove my contention. They had two patients in the hospital with nondescended testicles, and I was to pick them out from among ten patients. It was not difficult at all, but the uninitiated were much puzzled and perplexed. What was an almost miracle then is common property today, provided you will not forget what you have heard.

Another instance was in the case of a girl of thirteen, at the Neurological Institute. She did not menstruate as yet, and had slight petit-mal attacks. I was asked to see her, and according to my reputation of being

able to tell some things without asking any questions, I said that the child was entitled to have had mumps. Upon questioning her mother no mumps history was obtainable, and yours truly was ha-ha'd most uncharitably. For six months subsequent to this apparent fiasco the patient did not show up at the Institute. Then one afternoon she came, and when I inquired why she kept away for so long a time, I was compensated for my temporary discomfiture by the mother's statement that Vera had the mumps. The child displayed a slight adiposogenital picture, together with short, stunted, malposed laterals.

I was shown a few years ago, in a large hospital in this city a woman who had a laparotomy, with the object that I tell which side was affected. The surgeon also could not understand how I came to the correct conclusion.

But here I want you to carry away a most important and useful impression. Don't ever permit the removal of the appendix if a woman is suffering from a right ovarian neuralgia. And I hope your friends and relatives will benefit by your knowledge of endocrinology and be spared pain and expense. Look at the left lateral incisor, and convince yourself that it is absolutely normal before you permit the surgeon to go ahead.

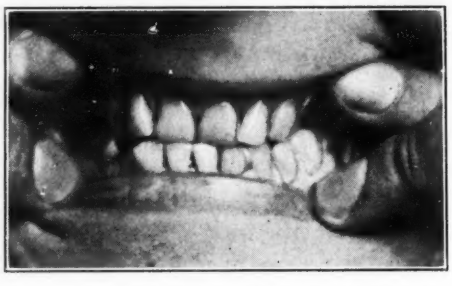


Fig. 11.

Long before the discovery of a number of elements Mendeléeff predicted their existence and formulated his well-known law in chemistry, known as "The Periodic Law," and long before the woman in the submitted photograph presented herself to my view I knew that the lateral incisors had something to do with the gonads. Her history will show you how well founded this endocrine tropism is, and how well it fits her gonadal misfortune.

This woman of forty-five came to the hospital for pains in the abdomen and left side. She had never menstruated, was married many years, was never pregnant. When I examined her mouth the striking feature was the entire absence of both upper lateral incisors. Upon questioning her about them I was told that they never erupted. I made a tentative diagnosis of congenital absence of primitive development of her gonads. By a careful gynecologic examination the adnexa were not palpable and a rudimentary uterus was found. Since then the utility of this sign has been established, at least in so far as I am concerned (see Fig. 10).

The reader will gather from what has been said that any individual possessing marked heterosexual stigmata carries this excess at the expense

of his own psychosomatic gonadal storehouse. Hence it is to be taken as significant of diminished masculinity if a man has to shave only once a week, has a squeaky voice, shows a gynecomastia, pubic hair with the apex downward, venus dimples over the sacrum, lack of hair on the shins, and an eye suggestive of exophthalmos. If the case is that of a woman who presents a hairy upper lip, or undeveloped breasts, or hairy shins, or a masculine distribution of the pubic hair (apex upward) she likewise does so at the expense of her psychosomatic femininity. The man and the woman of these types suffer. If they do not complain of any discomfort at the time they nevertheless possess certain characteristics in their demeanor sufficient to draw the attention of the critical observer. Their gonadal equipment is incomplete and often their complaints which have been classified as sexual neurasthenia for the sake of convenience, have received only superficial attention and if anything only makeshift therapy.

In the records of my friend and teacher, the late Dr. Joseph Fraenkel, will be found the case of a man who proved to be a nuisance to himself and others and a particular pest to the doctors whom he consulted, who was completely cured, much to the surprise of the man himself and his previous physicians, by a vigorous therapy with ovarian extract. He received other endocrines before but only the latter had an effect upon him. Cases can be multiplied but would introduce repetitions, and there are by no means instances lacking where women showed their only improvement after a suitable therapy with sperminum Poehl by mouth or injection.

For me to go into the hopeless domain of incurable teratologic defects, such as shown by the gonadal expression in cases of adiposogenital dystrophy or cases of gigantism would be a waste of time. Whether it is best to operate upon their pituitary in the absence of serious intracranial symptoms or not I leave to the surgeons. To my mind surgery will not untie the Gordian knot of their endocrine tangle. However, it is our power to alleviate their subjective discomfort by proper endocrine therapy, bearing in mind their gonadotropism. For the endocrine therapeutist, however, there is a vast field for doing wonderful work with those chronic headaches, pseudoepilepsies, sexual abnormalities and other conditions which show the tropisms described as gonadal in these pages. You will find the headache associated with the menstrual phenomena, that they have a certain periodicity, that they are supraorbital and occur in those who show one or more of the gonadotropic signs spoken of before. In the pseudoepileptic there will be an absence of tongue biting, no injuries, the patient will not display the abject hopelessness in his facial expression which invariably stigmatizes the incurable epileptic and there will be some sort of a hitch in his psychic or somatic vita sexualis.

Only half of the good will have been accomplished if we do not warn the patient against a too hasty oophorectomy, forgetting that much good can be obtained from a judicious endocrine therapy and also that every pain in the appendical region need not require the knife and that this pain may come entirely from a faulty ovarian function. Here an endocrine interpre-

tation will be of great benefit and save the patient from an unnecessary operation.

Now as to the use of the various endocrine products. Let me warn the beginner against all advertised products. Let me warn him particularly against the ready made diagnosis and the ready made shotgun pill. He who indulges in such therapeutics will learn nothing about endocrinology and will frequently do more harm than good. There are a great many manufacturing concerns who dry, rub and extract parts of various quadrupeds and sell them to the unusupecting medical public as endocrine products. Deal with long established reliable firms. Shun the business seeking firms who deluge your office weekly with literature which is less than useless in practical instances.

Now as to the drugs themselves. Let me inform the doctor that there are few instances where the firm gives due consideration to the endocrine status of the animal used for the furnishing of the particular gland desired. For instance, one will not deny the fact, unless he is totally ignorant of endocrine interrelationship, that an animal whose gonads are diseased cannot furnish a good gonadal extract, testicular or ovarian. Not only are the gonadal extracts useless from such an animal but the pituitary gland of such a beast also suffers and at the expense of its endocrine constitution. Such a pituitary extract may have certain biologic standards equal to the healthy and unchanged gland, but endocrinally it certainly cannot be as potent as the healthy animal's pituitary.

The crux in the manufacture of pituitary extract is had when we have to admit that our extracts are made chiefly from structures obtained from castrated bulls and steers. Such pituitary extracts, at best, do not come up to the requirements of discerning endocrinologists. Let us hope that this defect will be removed when endocrine therapy will play a rôle equivalent to its possibilities. Another drawback is the method of killing steers for the obtaining of suprarenal glands. Not only is the gland functionally altered as a result of its unbridled existence devoid of its gonadal check, but the steer is brought into contact with all the horrors so graphically portrayed by Crile when it views a row of slaughtered animals hanging with heads down and throats cut and gushing blood. His adrenal apparatus is profoundly affected, resulting in a desire to escape or to fight. Not infrequently such a scared animal runs loose in an abattoir making things lively for the slaughterhouse attendants. During this brief period the adrenals of the steer receive numerous demands for more adrenalin which must be sent into the blood stream in order to supply the muscles with defensive powers. The demand is continually increased even while the animal is being hoisted up and even while his throat is being cut and even for a few minutes after that. From this steer the adrenals are removed in a much depleted state and from such glands the manufacturers make their extracts. This is the story of the adrenals obtained from animals killed by the kosher method. The preliminary stunning of the steers such as is used in the west is much more desirable in that it eliminates to a marked degree agony adrenalin. Of course the blood pressure raising principle is present in all adrenals, but there are

factors other than pure blood pressure raising which are of importance to endocrinologists, and it stands to reason that during the brief period of time that the animal is subjected to such self-evident shocks that his adrenal equipment must suffer and that an extract made from such material is by no means the greatest desideratum.

Another endocrine product is ovarian extract and corpus luteum. The latter is and properly should be obtained from healthy pregnant cows. I have my suspicions about healthy cows being slaughtered, but until we obtain proper standardization of endocrine products by the government we will have to be satisfied with makeshifts. Mammary extracts are made from glands obtained from nonpregnant animals. There are very many purely technical considerations to be disposed of, but they are of no direct interest to the therapeutist.

Nor is the subject of endocrines exhausted without a word of advice to its administration. The chronic habit, and it is nothing but a habit, to prescribe drugs, with the exception of castor oil, to be taken three times a day, is a farce and entirely devoid of true therapeutic principles. If one dose accomplishes the desired effect there is no necessity to repeat it; if it is necessary to repeat it I do not see the advantage of giving it only three times a day. Why not every hour if we are anxious to obtain a therapeutic expression of its capabilities in a particular train of symptoms?

With endocrine products one has to deal carefully, and this is the reason why I am so much against the ready made diagnosis and the accompanying suggestion of the manufacturer who takes upon his shoulders the onus of the expert and tells the doctor to give this in petit mal or that in ovarian neuralgia, or in a dozen other conditions. If one cannot work out his own therapeutic salvation the manufacturer of drugs with hit or miss tactics will never help you.

In prescribing thyroid extract begin with small doses only, less than a quarter grain, for many unforeseen unpleasantnesses may arise when a beginner uses this drug. There are instances when one may give as much as thirty grains a day, but before doing this one must be absolutely certain that it will do no good in smaller doses. Suprarenal extract by mouth may be given from one-sixth up to one grain at a dose, repeated as often as is necessary, even up to a dose every half hour. Ovarian extract must be used in larger doses, say one grain every one or two hours as the case may be. Of mammary extract I have given as much as 120 grains a day for a week and obtained my result in removing the depression of a girl of fifteen, whom I consider a beginning dementia praecox. I do not state that a cure occurred in this instance, but only wish to bring out the size of the dose and its effect, at least in this instance. As yet we have found no cure for this disease, even with the endocrine drugs.

Pituitary extract gave me a great deal of satisfaction in a few cases of epileptiform attacks and I used it rather sparingly, giving one quarter grain every other day and watching the outcome. It removed in a few instances the tongue biting, in others the duration and severity, and in all the great prostration and temporary lethargy that follows the convulsions. For cer-

tain headaches pituitary extract is of invaluable utility, but it must be given with caution. In gonadotropic states, physiologic or pathologic (gonado-advent or gonadopause) this extract is frequently the only drug which will remove the great host of inconveniences from which the patient comes for relief. In the psychogonadal syndromes one will have to use seriatim, pituitary, gonadal extracts or suprarenal gland extract. The latter will occasionally do wonders, and in a short time. A combination of adrenal and gonadal extract was of transient and temporary use in a few cases of dementia praecox but its effects upon this disease cannot by any means be considered as even approaching a cure. Lack of space prevents me from going deeply into the finer therapeutic technicalities, and I shall consider this communication as having done its bit of good if the doctor will use his own diagnosis and try for himself, beginning with small doses at infrequent intervals the many single endocrine drugs (not using combinations at all), and establish the utility of animal gland extracts for himself.

EQUIVALENTS

THE ENDOCRINES

	Dose	
1. Thyroid	$\frac{1}{4}$ grain to $\frac{1}{2}$ grain	once or twice a day.
2. Suprarenal	$\frac{1}{2}$ " " 1 "	
3. Pituitary	$\frac{1}{4}$ "	

HOMEOPATHIC

1. Spongia and Lilium trigrinum	3×	one every hour.
2. Sulphur and Ignatia amara	3×	
3. Lycopodium and Pulvatilla	3×	

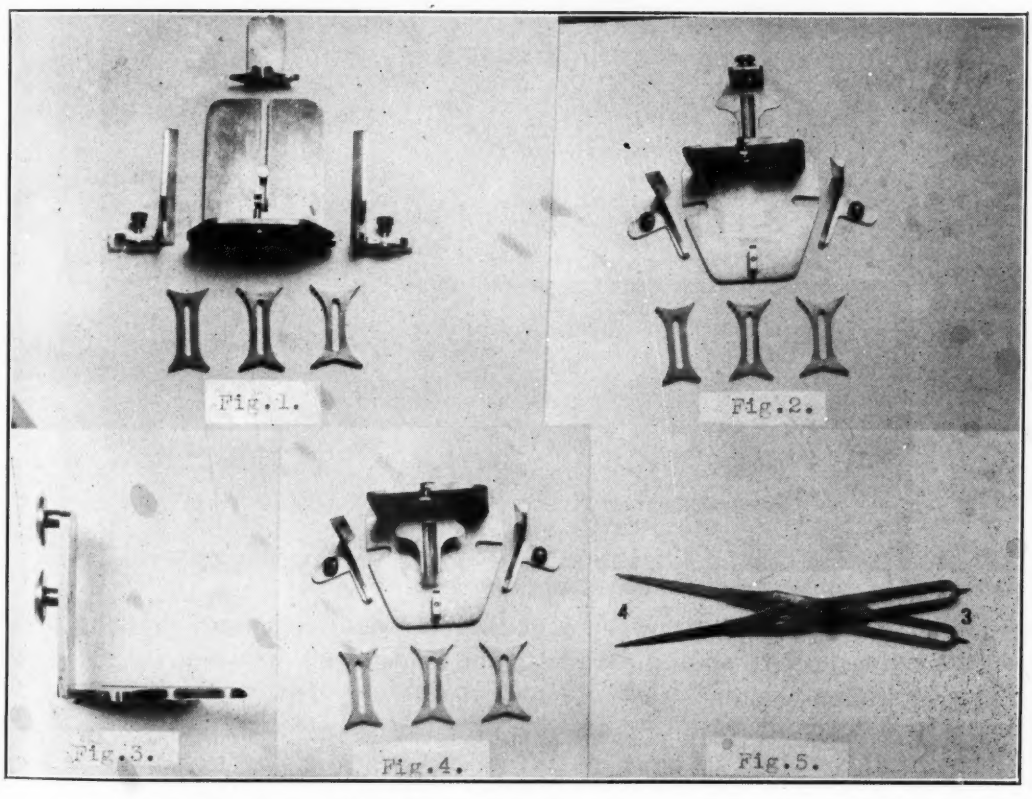
ORTHODONTIC PLASTER MODEL FORMER*

By Dr. Lowrie J. Porter, New York City, N. Y.

THIS instrument has been designed to facilitate the more or less tedious task of artistically making the plaster casts which serve as dental records of the occlusion of the teeth.

Other instruments have been originated, the most successful of which were made with the idea of mechanically carving the roughly poured plaster casts into the shapes desired.

The objection to shaping the models by a molding process has been that there has been no way of definitely occluding the teeth while pouring the



mold, which was necessary in order that the upper and lower art portions would be of the correct height, with the bases parallel and the front, back and sides at right angles to the bases.

The instrument herein described is able to give a perfectly balanced model with practically no carving whatsoever, and is able to save a vast amount of time in the laboratory over the former methods of hand carving.

At the present time this instrument is being made of nickeled brass. although it may later be made of bakelite or some other substance.

*Clinic presented before the First International Orthodontic Congress, New York City, Aug. 16-20, 1926.

PARTS OF MODEL FORMER

There are in all nine main parts, as follows: (1) base with perpendicular back attached; (2) sliding plane (large size for large models); (3) sliding plane (small size for small models); (4) adjustable stop to determine position of sliding plane; (5 and 6) right and left adjustable side arms; (7, 8, and 9) anterior sections (three sizes for forming the anterior part of small, medium and large models). It may be noted that the anterior sections are rounded on one end to form the anterior of a lower model, and angular on the other end to form the anterior of the upper model.

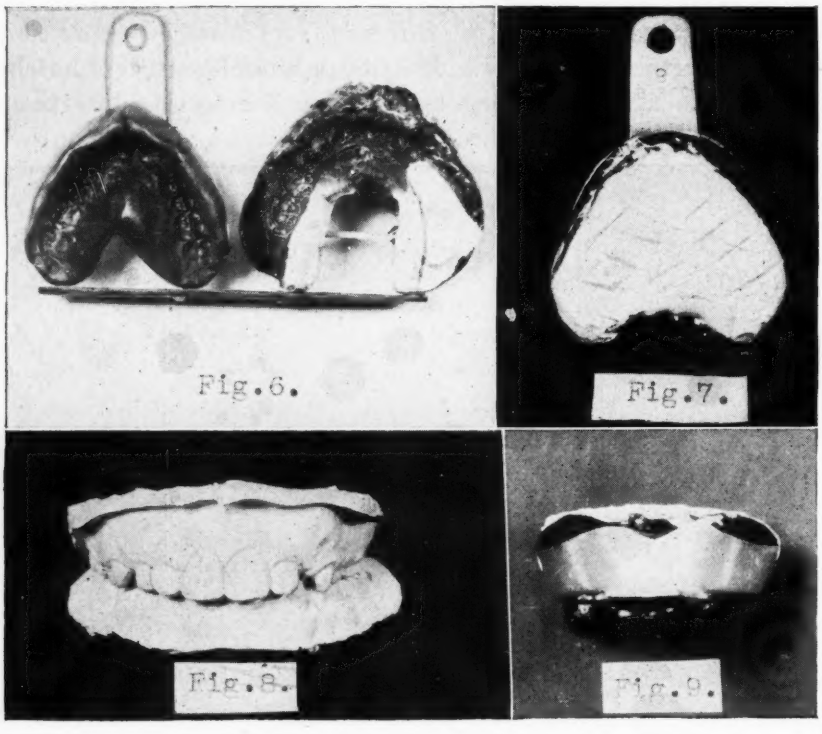


Fig. 1 shows an anterior view of the base and back with the side arms on the right and left, sliding parallel plane above (only one shown) and three anterior sections below.

Fig. 2 shows the top view of same.

Fig. 3 is the top view of the sliding parallel plane.

Fig. 4 shows the sliding plane when in sliding or working position on the perpendicular back.

Fig. 5 shows the adjustable dividers which have been set at a 3 to 4 ratio. This ratio has been established since the art portion of the model should be one-third of the anatomic portion. Thus the anatomic is three parts to four parts for the entire model.

A pair of dividers is now being made with three adjustments of 1, 3 and 4 ratio: 1 for the art portion; 3 for the anatomic portion; and 4 for the height of the finished model.

TECHNIC

An impression is taken either in plaster or compound as desired, as in Fig. 6. This is filled level with the top of the impression (Fig. 9) and is roughened on the top (Fig. 7) to help the adherence of the plaster which is later added to form the art portion. It is well to use stone plaster (Healy's white stone plaster) for the teeth and anatomic portion as this is very hard and not easily broken and thus makes a very lasting record.

Fig. 10.

Fig. 11.

The models are then separated from the impression after they are sufficiently hard, which gives models with a rough overhanging edge as shown in Fig. 8. These edges are trimmed close to the gingival portion as in Fig. 10, in order that the overhanging edges will not interfere with the placing of the model in the form.

FORMING UPPER MODEL

We are now ready to form the upper model. This is done by adjusting the form to the proper size, pouring the soft plaster in the mold and pushing the upper model into the soft plaster the proper distance to give the correct base or art portion.

The first step is to cover the anatomic part of the model with adhesive tape (Fig. 11) to prevent the soft plaster from adhering to the anatomic part

of the model when it is pushed to place. Adhesive tape is used as it has been found superior to wax in that it is easily adapted, easily removed, sticks well, and is very thin. In case any trouble is found from the adhesive material sticking to the model from long standing, it is easily cleaned with a little chloroform on a cotton roll.

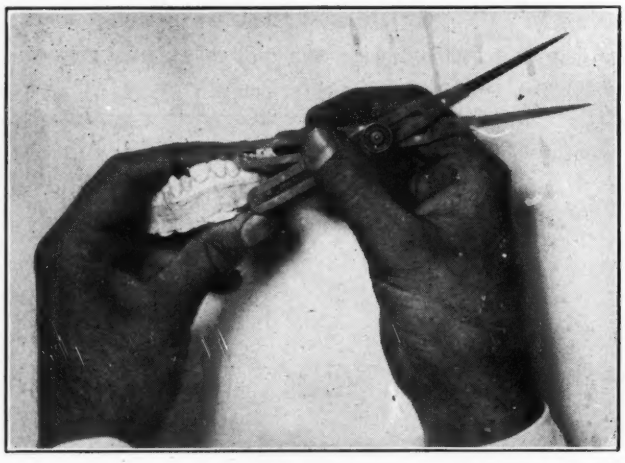


Fig. 12.

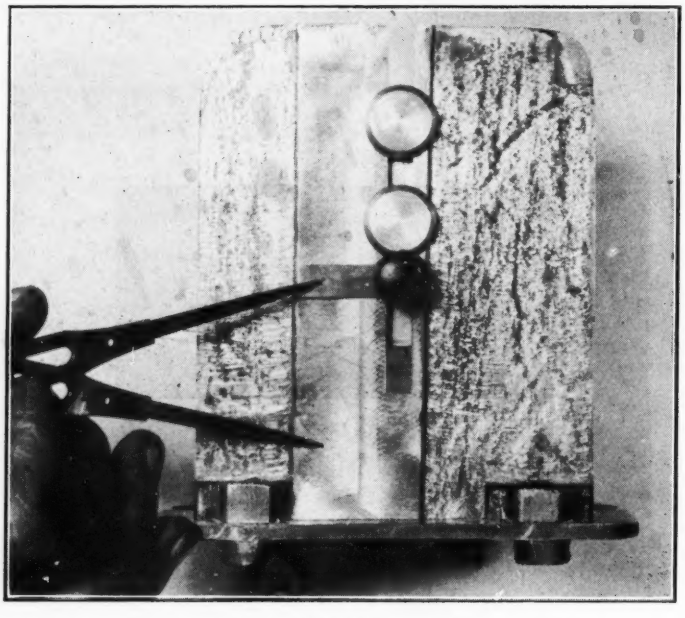


Fig. 13.

MEASURING UPPER MODEL

The dividers, which have been adjusted to a 3 to 4 ratio, are now used to determine the height of the upper model. As above described the smaller end of the divider, which has been set at a 3 ratio, is used to measure the anatomic portion. The opposite end, which is the 4 ratio, will give the total height of the upper model from the occlusal plane to the base, since the anatomic portion is three-fourths of the entire upper model (Fig. 12). Thus the

art portion will be one part; to three parts for the anatomic portion; to four parts for the entire model.

ADJUSTING SLIDE PLANE STOP

A slot will be found in the perpendicular back of the instrument, in which slides the parallel plane and adjustable stop for this plane. There will also be noted on the back a point depression on the metal and a similar point

Fig. 14.

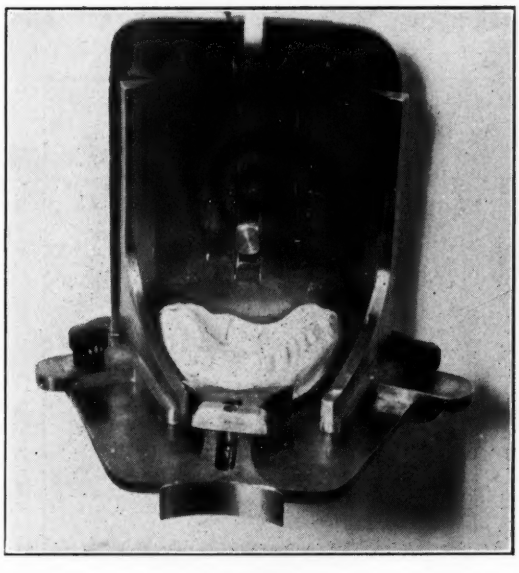


Fig. 15.

depression on the extension of the adjustable stop. The adjustable stop is now set so that the measurement made with the dividers for the height of the model will coincide with the height of the sliding plane from the base when resting against the stop. To do this, one point of the divider is placed in the point depression on the perpendicular back and the stop adjusted until the other point of the divider rests in the point depression in the extension of the

adjustable stop (Fig. 13). It will be noted in this illustration that the sliding plane is resting against the stop button.

SELECTING THE ANTERIOR SECTION

The anterior sections are made in three widths, varying about 1/8 of an inch from canine to canine, to accommodate small, medium and large models. The proper width is then selected as in Fig. 14.

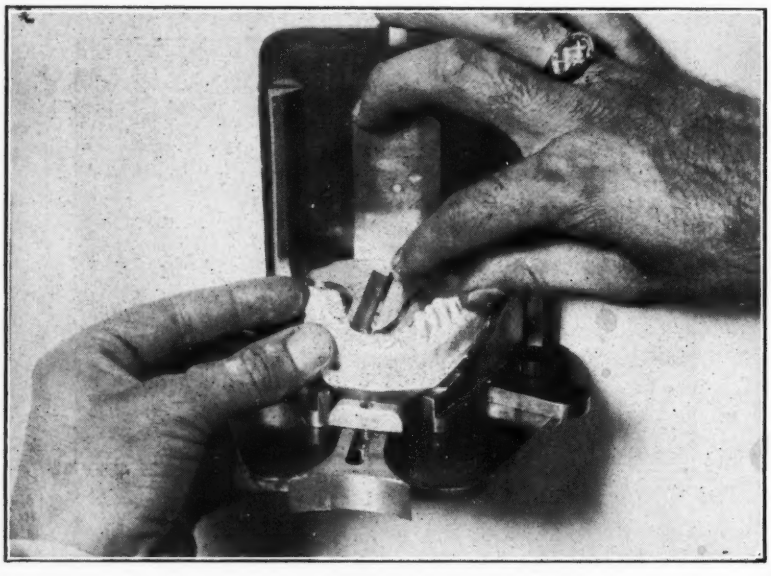


Fig. 16.

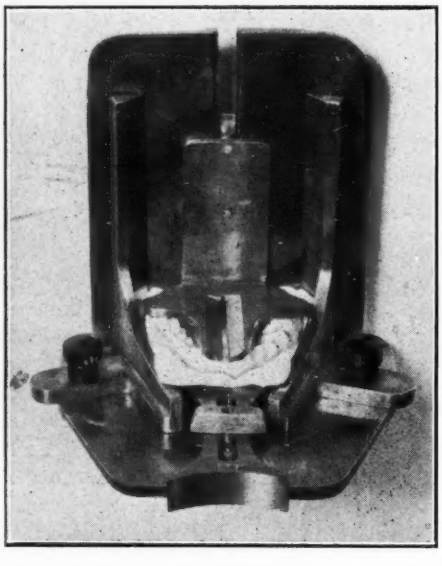


Fig. 17.

ADJUSTING THE FORM

The model is now placed inverted on the instrument base and the front section brought to the proper place and tightened with the thumb nut (Fig. 15). The side arms are then brought to place parallel to the lines of occlu-

sion and tightened with the thumb nuts. It is often better to hold the model up from the base somewhat in adjusting these parts.

The form is now filled with soft plaster and the anatomic part of the model, with the adhesive tape in place, is allowed to rest on the soft plaster in its proper position (Fig. 16).

The sliding plane then pushes the model down in the soft plaster until the plane comes to the position of rest as set by the adjustable stop. In Fig. 17

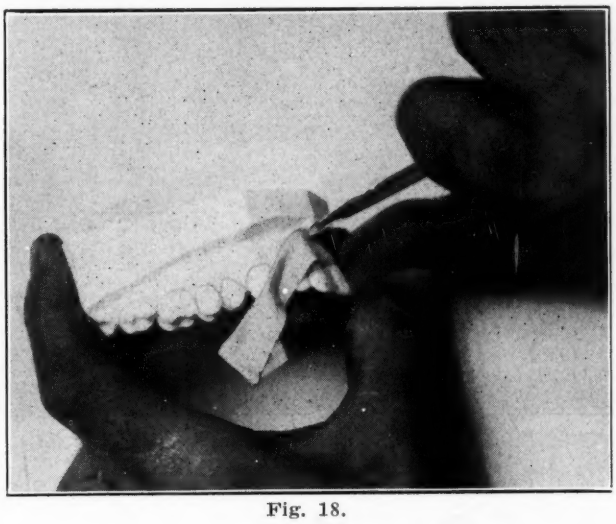


Fig. 18.

Fig. 19.

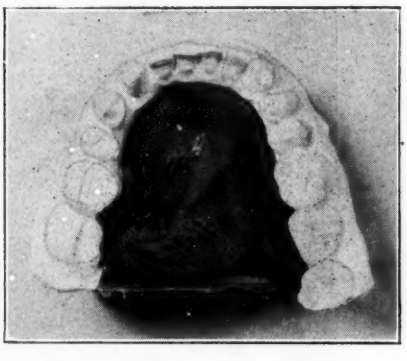


Fig. 20.

it will be noted how the soft plaster has been pushed up over the adhesive tape.

The median line should fall under the slot in the sliding plane. This will be between the centrals in cases where the median line of the face falls between the centrals. In cases where the teeth are not in the center of the face this would vary accordingly.

A model thus made will have the plane of occlusion of the upper teeth parallel to the upper base. In cases where this varies, such as elongated upper anterior teeth, etc., a piece of wax may be temporarily added to the occlusal surface to take care of this while pouring the model.

REMOVING FROM INSTRUMENT

Since the instrument is kept highly polished, it has not been necessary to use any grease to make the model easy to remove. The side arms and front section are quickly removed and the model slid off the base.

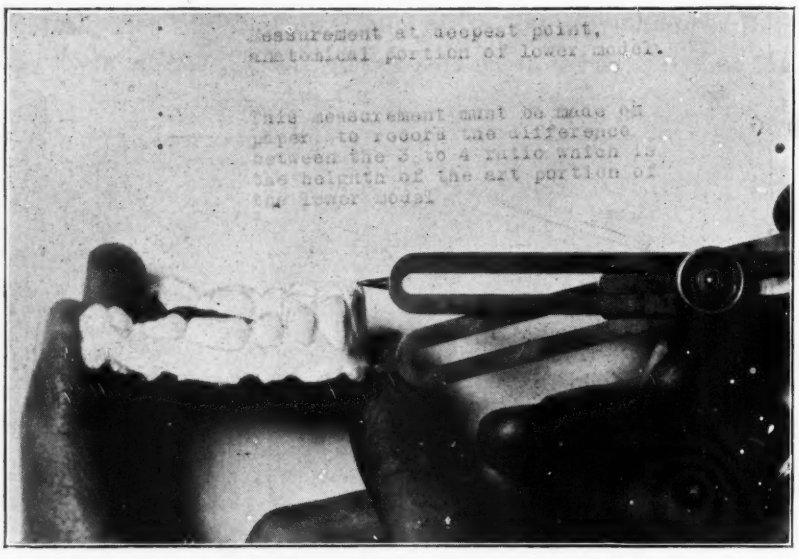


Fig. 21.

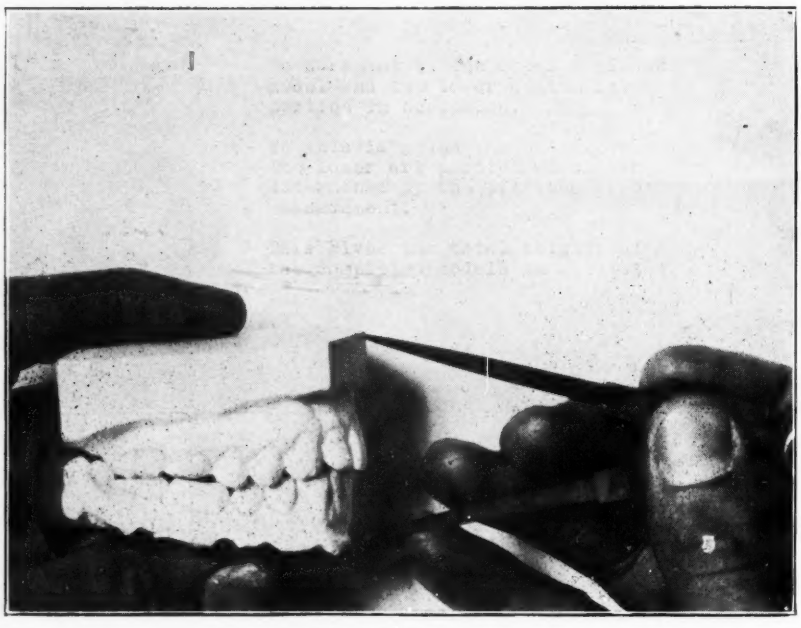


Fig. 22.

FINISHING UPPER MODEL

The excess plaster is now trimmed away to the upper edge of the adhesive tape and the adhesive tape removed (Fig. 18). The knife should trim at right angles to the model so there will be no shadows from overhanging sides in case at some time one might want to photograph the models. If the opera-

tion has been done correctly, the art portion will be exactly one-third of the anatomic portion, and will be very artistic in appearance.

Fig. 19 shows the completed upper model with no trimming whatsoever except taking off the excess plaster over the adhesive tape.

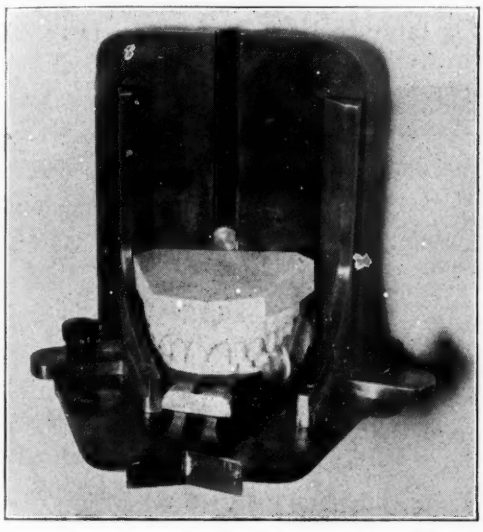


Fig. 23.

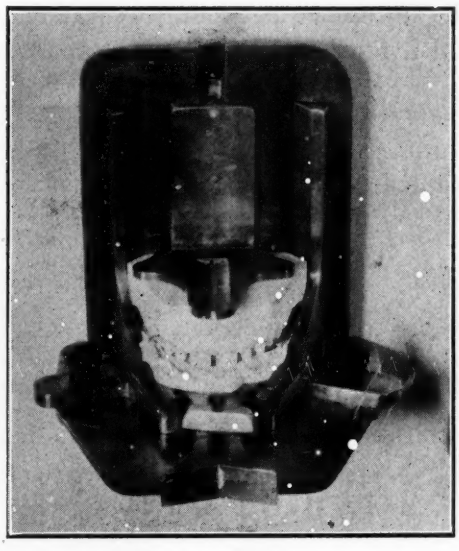


Fig. 24

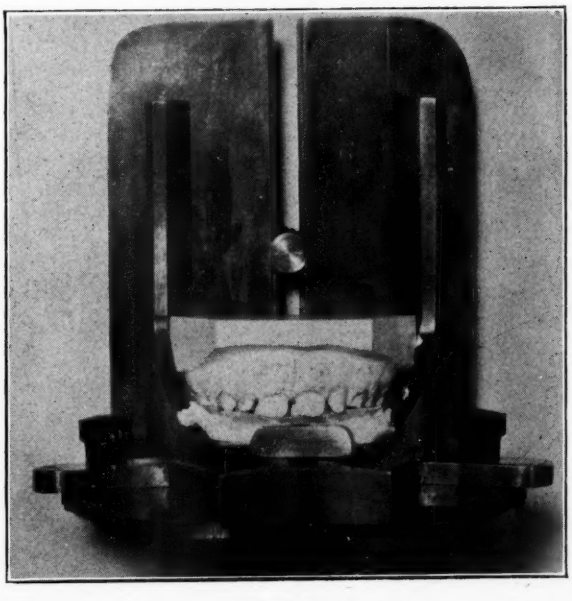


Fig. 25.

PREPARING LOWER MODEL

When pouring the lower model a layer of wax may be added to the lingual of the impression and plaster poured over this as well as the anatomic portion to fill in the lingual, or after the model has been poured, a little soft compound may be used to fill up the lingual, in order that the soft plaster

will not be pushed up in the lingual when the anatomic part is forced into the soft plaster (Fig. 20).

MEASURING FOR LOWER ART PORTION

The lower anatomic portion is now measured the same as the upper was. The difference between the 3 and 4 ratio is the thickness of this art portion and it must be recorded on paper as it is later to be used again. (Fig. 21.)

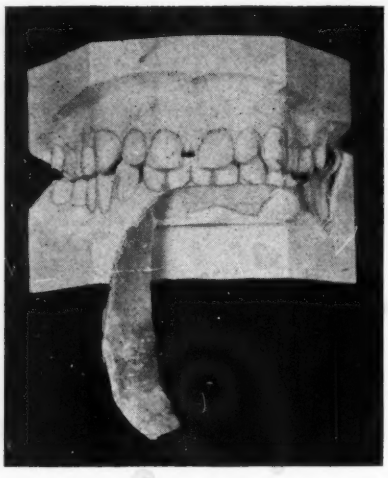
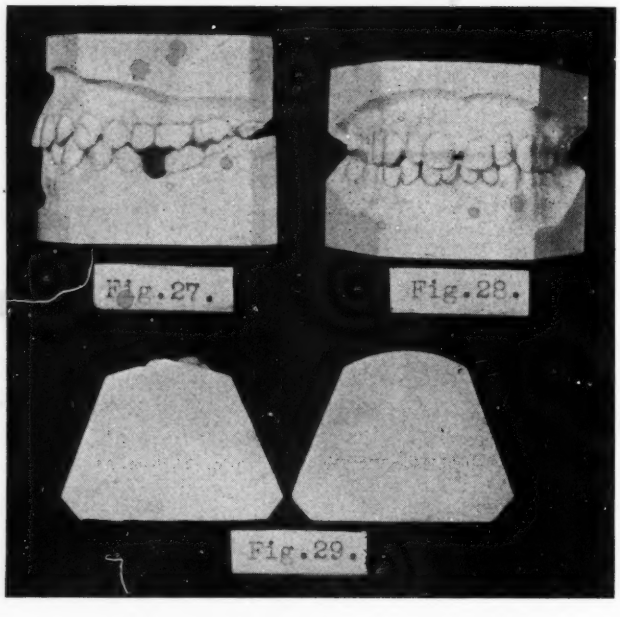


Fig. 26.



MEASURING FOR TOTAL MODEL HEIGHT

The upper finished model and the lower anatomic portion are now waxed together in the proper occlusion in order that there will be no change of the occlusion while forcing down in the soft plaster.

Now measure from the top of the upper model to the lowest point of the lower anatomic portion (Fig. 22). To this add the thickness of the lower

art portion which was just figured and recorded on paper. This will give the total height of the model when finished. The adjustable stop on the back of the instrument should now be set for this measurement.

ADJUSTING LOWER MODEL FORM

Adhesive tape must be put on the lower the same as was done on the upper.

The occluded models are now placed on the instrument base and the anterior section brought to place with the rounded end toward the model and locked in position. Then the side arms are adjusted to fit the upper finished model (unless it is desired to have the shape of the upper and lower models different) (Fig. 23).

POURING LOWER MODEL

The form is now filled with soft plaster and the occluded models pushed into the soft plaster with the sliding plane (Fig. 24). The back and side arms serve as guides to get the back and sides parallel with the upper. Since the sliding plane is parallel with the base, the upper and lower bases must necessarily be parallel when finished.

Fig. 25 shows the model after it has been pushed into the soft plaster and the sliding plane removed.

FINISHING LOWER MODEL

After the plaster is hard, the lower model is removed from the instrument and the excess plaster trimmed and the adhesive tape removed the same as was done with the upper model (Fig. 26).

If the operations have been done correctly there should not have been more than twenty minutes to a half an hour's time spent in producing the very artistic and perfect models as seen in Figs. 27, 28, and 29, after the anatomic portions have been poured and separated.

NOTE: At the date of this publication the instrument is no longer made of metal but has been found to be much better when made of a very hard pressed bakalite with monnell metal anterior sections, which allow a wide range of adjustment. Cocoa butter is used as a lubricant to prevent the plaster from sticking to the bakalite.

REPORT OF THE PRESIDENT OF THE FIRST INTERNATIONAL ORTHODONTIC CONGRESS

THE First International Orthodontic Congress held in New York City, August 16 to 20, 1926, is now a matter of history. Its critics, so far as I have been able to learn, have been exceedingly kind in their words of commendation of the efforts and results of the officers and committeemen who labored so arduously and faithfully to bring it about.

Whether it was a one hundred per cent success only time can tell. Unless great good in the way of a stimulus for even finer and higher ideals is felt, then the Congress cannot be considered to have been a complete success. It is highly probable that the adverse criticisms have been kept from my ear and that the kindliness which rests in the hearts and minds of most men has been responsible for my having heard only the most pleasing words of commendation.

But assuming that what I have heard, namely, that it was a grand success, to be the consensus of opinion of nearly, if not all of the majority of its seven hundred and fifty members, I want at this time to again express my personal unbounded appreciation and praise for the wonderful work of the various committees and those members of the Board of Governors whose proximity to New York made them active workers. Never have I been associated with a professional organization in which there was such hearty cooperation and wonderful teamwork; not that one or two upon whom we would rest burdens of responsibility did not fail to respond, but their number was so small and the willingness of others to do their work so great that their failure to shoulder their particular assignment was not felt in the final result.

For the first time in the history of the specialty those commercial houses particularly interested in supplying the needs of the orthodontists were privileged (and I believe that they considered it a privilege) to contribute to defraying the expenses of the Congress, and to them I want to extend the appreciation of the Board of Governors for their support.

Were I to mention by name all of the members of our specialty who so willingly contributed either in the management of the Congress or in the presentation of essays, case reports, clinics and exhibits or in the discussions, it would sound almost like a roll call of the several component societies. I will not mention any one name, but you who attended the Congress know very well those men whose untiring efforts and devotion made possible the grand success.

When the Congress was first broached in 1924 few realized the magnitude of the undertaking, and as late as 1925 and the early part of 1926 the question of financing this stupendous meeting was considered in a very serious manner by the Board of Governors. It is true that we had in the Constitution and By-laws a clause whereby if there was a deficit it would be cared for by the

component societies in America in proportion to their memberships. It was not until the early part of 1926 when I had assured the Governors that I practically had a guarantee for the sum of one thousand dollars in case there should be a deficit that the Governors began to see the light of day so far as the finances of the Congress were concerned.

I hope it will be the most welcome and satisfactory news to you when I tell you that it was not necessary to call for this contribution and that we were able to care for the very heavy expenses of the Congress and that it is fully expected that when all of the accounts are finally settled that we will have approximately five hundred dollars to turn over to the Treasurer of the Second International Orthodontic Congress as a nucleus for their work.

Before closing this report I desire to call your attention to the proceedings which you have probably received by this time. This very fine contribution to the literature of our specialty in such a useful and attractive form was made possible through a business deal made by your Board of Governors with The C. V. Mosby Publishing Company. We realize the favorable terms which Doctor Mosby extended to the Congress and we appreciate the fine manner in which they have endeavored to live up to their part of the contract.

It will be impossible for the treasurer to render what might be termed a detailed financial report for some little time, yet you will probably be surprised to know that there are certain outstanding indebtedness which we have been unable as yet to adjust and pay, but I can assure you that there are ample funds in hand to take care of any such indebtedness.

I want in closing to express, particularly to the members of the American Society of Orthodontists, my great appreciation of the honor which they bestowed upon me in electing me President and so warmly immediately endorsing my original suggestion and plan for an International Congress; it was that honor which you conferred upon me that gave me the confidence to attempt this great meeting.

(Signed) Wm. C. Fisher.

501 Fifth Avenue.

ABSTRACT OF CURRENT LITERATURE

Covering Such Subjects as

ORTHODONTIA — ORAL SURGERY — SURGICAL ORTHODONTIA — DENTAL RADIOGRAPHY

It is the purpose of this JOURNAL to review so far as possible the most important literature as it appears in English and Foreign periodicals and to present it in abstract form. Authors are requested to send abstracts or reprints of their papers to the publishers.

Protective Action of Saliva on the Teeth. A. L. Spencer-Payne. The Pacific Dental Gazette, January, 1927, xxxv, 1.

This paper appeared originally in the *British Dental Journal* and has apparently been reproduced by other periodicals. The saliva doubtless stands in some definite relation to the welfare of the teeth and when its flow is checked the latter become coated with sordes which condition of stasis ought to favor the development of caries. Not only the rapidity of flow but the reaction of the saliva must be reckoned with. There is much confusion in respect to the indicators used in estimating reaction for while a given saliva may be alkaline to litmus, it may be acid to phenolphthalein. The only trustworthy method of determining reaction is the hydrogen-ion concentration. A low degree of acidity can count as neutral for it cannot decalcify the enamel and to act upon the latter the concentration should be 4 and upwards. The indicator methyl orange shows a difference of behavior at about this figure so that it is handy for routine testing, as indicating the neutralizing power of the saliva. In theory the presence of buffer substances in the saliva in the form of phosphates and bicarbonates could invalidate this reaction test but in practice this disadvantage can be overcome by using a standard control solution. In addition to modifying the reaction they also interfere somewhat with the neutralizing power of the saliva, so that the use of the methyl orange test has a very limited significance, save in checking up other results.

To attack the problem from another angle wherein does the immune mouth differ from the mouth of caries? One authority states that the former is slippery and the latter sticky in quality which is not only vague but open to doubt. Leaving the question of reaction open another factor is the digestive power of the saliva, for according to one writer saliva with amylolytic power is responsible for the fermentation of the food débris and hence for caries. This cannot be verified entirely but it seems certain that some caries-immune animals have no ptyalin in their saliva. Statements concerning the calcium content of saliva and its possible effects on caries are conflicting although there is some ground for the belief that a little calcium may enter into solution in the saliva under certain conditions. But in enamel thus weakened the calcium may be again taken up from the saliva, so that this line of

research and speculation seems to lead nowhere. If enamel is placed in a synthetic saliva it may be shown to gain weight. These speculations tend to show what a complicated problem the origin of caries must be and it does not seem probable that it can ever be summed up in a simple formula.

Relation of Oral Sepsis to Disturbances of the General Health. L. F. Barker, M.D. (Baltimore). The Dental Cosmos, January, 1927, lxix, 1.

Professor Barker, the well-known internist of Johns Hopkins, distinguished also as an anatomist and neurologist, the successor of the late Sir Wm. Osler, gives his matured views on this subject, based on many years of weighing evidence. He takes issue with those who would extract three-fourths or more of the pulpless teeth encountered and does not find their arguments convincing. Mere presence of bacteria in pulpless teeth cannot be construed as evidence of potential or actual damage to the individual, nor is the fact that cultures of such germs can sicken rabbits of any significance. The claim that the composition of the blood is deranged by pulpless teeth, thereby showing lowered resistance to infection cannot be taken seriously and this is true also of the alleged lymphocytosis. The matter of the elective localization of certain bacteria in certain structures is still under judgment, supported as it is by animal experiments which are inconclusive. A survey of the work of the laboratories shows that great differences exist between the results attained by conscientious workers who are merely seeking the truth and those which are forced in the interest of some preconceived theories. The author calls the latter false research which not only leads nowhere but does actual harm. There are certain laboratory men whose names inspire confidence, men of the type of Welch, Flexner, Cannon and many others, and others who are quite without the necessary training, temperament and conscientiousness to pursue original research. We must not accept any dicta as final unless they have the endorsement of men of the first type.

Dental Caries and Tooth Conservation. J. B. Robinson (Baltimore). The Dental Cosmos, February, 1927, lxix, 2.

The author says of caries that the following is universally conceded, caries do not take place without the presence of bacteria in contact with the enamel and in the presence of carbohydrate foods. It is not set up by any one form of bacteria and any of eight or ten species is able to produce it; but certain species may play a dominant rôle and of late years the Bacillus acidophilus seems to be the first in the field and to be constantly present. As a matter of fact all supposed bacteria of caries have it in common that they are acid formers and able to produce acid by the fermentation of carbohydrates. Caries begin in certain depressions where food collects. Pits and fissures are ideal nesting places and Hyatt as is well known advocates stealing a march on the future caries by preparing these defects to resist the carious process by prophylactic filling. Prophylaxis of recurrence involves the reestablishment of proximal contact and restoration of normal occlusal relations. Diet is probably of prophylactic value in as far as exclusion or reduction of sugars and

other carbohydrates is concerned and also in respect to foods which require mastication and at the same time naturally cleanse the teeth. No suggestions are given as to individual food articles. The author quotes Bunting as to the unsatisfactory use of the term prophylaxis by the public which implies that this is synonymous with the use of the toothbrush. Cleanliness is but one of the prophylactic resources and involves much more than simple brushing for it comprises scaling and the removal of stains.

Stomatologic Radiology in Public Hygiene. O. Weski (Berlin). Medical Journal and Record, January, 1927, cxxv, 2.

Many new questions continue to arise in reference to the small region of the alveolar process, the answer to which will be of the greatest importance to odontology. The older dentists are still indifferent to radiology but the problem is national and not merely personal. The teeth of the nation are a most valuable asset. Our attempts to reach the teeth of the school children are at present crude for only the more glaring defects are recognized and treated when the pulps are already infected. The ideal is to prevent this infection of the pulp. If infection and gangrene have occurred it is important to study the reactive processes in the jaw and whether the ramificatory region has been perfectly filled and if the granulomas have been cured by the treatment instituted. Further it may be possible to avert those extractions which are often needless. The responsibility in certain cases may be shifted to the patient when the latter refuses treatment. Extraction should be our last resort and done only after the most exact diagnosis. The roentgen ray is also of the greatest value for affections of the alveolar margin. The author as is well known prefers the term paradentosis to paradentitis for the inflammatory factor is not the essential part of pyorrhea. He makes no distinction between senile shedding of the teeth and the paradentosis of middle life. In many cases of the latter there is no pyorrhea. Certain workers in metals and chemicals rapidly develop paradentosis after exposure and illustrate what may be done by prophylaxis. It is not generally known that paradentosis can set up pulpitis in a retrograde manner. The author is the head of a group of stomatologists established in 1924 for the study of paradentosis for the purpose of working out a system of treatment based on roentgen diagrams.

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EDITORIALS

The Twenty-Sixth Annual Meeting of the American Society of Orthodontists

THE Twenty-Sixth Annual Meeting of the American Society of Orthodontists held at the Edgewater Beach Hotel, Chicago, on Monday, Tuesday, Wednesday, and Thursday, May 2, 3, 4, and 5 was the largest meeting ever held from the standpoint of attendance. It also established a record for the number of papers, case reports, and clinics presented.

The meeting was marked by the consideration of a number of constitutional amendments, the most important of which was the question of raising the dues from ten dollars to twenty-five dollars. Some of the officers of the Society believed the dues should be raised, but they failed to present their case in such a manner as to impress the majority of the membership. It is true that the International Orthodontic Congress received all the dues collected from

the American Society of Orthodontists in 1926, which made it necessary for the expenses of the Society to be paid out of the surplus in the treasury. However, in spite of that fact, there was a sufficient balance in the treasury to impress the majority of the membership as being sufficient for the needs of the Society. The officers may have had some information in regard to the expenses of the Society that was not made public to the membership or they may have had plans for the future of the Society that were also unknown to the general membership.

In order for a constitutional amendment to be adopted it must be passed by a three-fourths vote and it was rather surprising to find that the question of raising the dues was defeated by a vote of 56 against increasing the dues and 39 in favor of increasing them. After this resolution was defeated Tuesday, on Wednesday morning a notice was filed that a motion to reconsider the vote would be made at the business session on Thursday morning. This motion was made by Dr. Murless; but after considering the matter and discussing it with some members of the Society, it was decided not to make a motion to reconsider the action of the Society on Tuesday but to introduce a standing resolution assessing the membership five dollars per member annually for a period of three years. The resolution was as follows:

WHEREAS: In the opinion of some of the officers of the American Society of Orthodontists, a condition exists where it is important for the officers of the Society to have an increased amount of funds for properly conducting the affairs of the Society and whereas it is important for these sums to be secured before the annual collection of dues for 1928.

BE IT THEREFORE RESOLVED: That the members of the American Society of Orthodontists in regular assembly at this Annual Meeting assess each member five dollars per year for the years 1927, 1928, and 1929.

BE IT FURTHER RESOLVED: That this standing resolution shall become operative after the collecting of the third annual assessment in 1929.

As the American Society of Orthodontists has a membership of approximately 250 members this will give the officers an additional sum of $1250 annually for the next three years. It will give the officers of the Society an opportunity to show that they can give the membership a better meeting with the assessment than they could with the annual dues of ten dollars. If the officers of the Society are able to demonstrate an increase in the value of the meeting, they will have little difficulty in overcoming the sentiment concerning a raise in dues, that was shown at the recent meeting.

The amendment dealing with the creation of a fellowship which was presented by Dr. William C. Fisher at the meeting of the American Society of Orthodontists in 1926 was virtually recalled at the request of Dr. Fisher. However, he stated that after due investigation he was of the opinion that the creation of a fellowship in the American Society of Orthodontists was not the wisest thing. As the resolution creating the fellowship was introduced as a constitutional amendment, it was necessary to take a vote on the matter which, of course, resulted in its defeat.

An unusual feature of the meeting were the competitive clinics which were arranged for by the President, Dr. Joseph D. Eby.

The Southwestern Society of Orthodontists presented seventeen clinics under the able management of P. G. Spencer as chairman.

The Pacific Coast Society of Orthodontists, with Harvey A. Stryker, as chairman, presented four clinics.

The Rocky Mountain Society of Orthodontists, with William R. Humphrey as chairman, presented three clinics.

The Southern Society of Orthodontists, with Claude R. Wood as chairman, presented eighteen clinics.

The Great Lakes Society of Orthodontists, with Harry Hosmer as chairman, presented four clinics.

The New York Society of Orthodontists, with Lowrie J. Porter as chairman, presented twenty-five clinics.

The President, Dr. Joseph D. Eby, appointed judges to vote on the merits of these competitive clinics. The point taken into consideration was the number of clinics presented in comparison to the number of different societies. A silver cup was presented by Dr. Eby to the Society having the best all-round presentation. The cup was awarded to the New York Society of Orthodontists, the committee giving special mention to the Rocky Mountain Society.

An interesting feature of the meeting was the scientific exhibits which included case reports, methods of treatment, radiographic technic and demonstrations of various methods of appliance construction. It was very evident that the man in charge of the scientific exhibits had spent many hours in arranging them so as to present the best possible appearance. Some expressed a desire that the scientific exhibits be made a permanent part of the meeting, but we very much doubt the advisability of such a procedure owing to the tremendous amount of work involved.

The officers and the committees are to be congratulated on the excellent program that was presented at this meeting.

ORTHODONTIC NEWS AND NOTES

The Meeting of the American Society of Orthodontists Held May 2, 3, 4 and 5, 1927, Chicago, Ill.

THE Twenty-Sixth Annual Meeting of the American Society of Orthodontists held at Edgewater Beach Hotel, May 2, 3, 4, and 5 is now a matter of history.

For variety, magnitude of program and general interest, the Twenty-Sixth Annual Meeting will probably go down in the memories of the majority of those in attendance at least, as the most outstanding meeting this Society has ever been privileged to enjoy.

The attendance was large, there being over one hundred seventy-five registered. Undoubtedly, if all who attended the meeting had registered there would easily have been two hundred in attendance. Orthodontists from all parts of America were in attendance, there being no less than six or seven men from the Pacific coast. The Atlantic coast as usual was represented by a large turn out, they having chartered a special Pullman and made the trip en masse.

The South and Canada were equally well represented,—Houston, Dallas, Montreal and many other cities in Canada.

One of the past Presidents of this Society, of an administration of many years past, was heard to say at the banquet that it was almost inconceivable that the little band he was identified with twenty years ago could grow to the flourishing Society that it is today.

One of the best known and outstanding specialists in the world in dentistry (not an orthodontist) was heard to say he believed this organization to be the most virile, vigorous, and enthusiastic as well as fraternal organization in dentistry that there is in existence. This is a most fortunate circumstance and undoubtedly, is the best index of the future which is held in store for this specialty that it might be possible to secure.

The program, if it were possible to criticize it, might be said to be overloaded. Too much to hear—too much to see—all at the same time.

A great deal of credit is due Dr. Joe Eby, President, and particularly, the Chairman of the Board of Censors, Dr. Oren A. Oliver, who was untiring in his efforts to provide this outstanding and most interesting program.

There was a banquet on the evening of the second day given to the past Presidents of the Society. Each past president in turn was called, beginning with the name of Dr. Edward H. Angle (who unfortunately was unable to be present), first President of the American Society of Orthodontists, and asked to rise and, by a sponsor who had been previously appointed, was presented with a token of good fellowship, esteem and good will of the American Society of Orthodontists. Each past president received a golden key with the

name of the American Society of Orthodontists engraved upon it in Greek lettering. He was also presented with a beautiful composite photograph suitable for framing containing the pictures of all the past presidents of the American Society of Orthodontists. This picture was beautifully done and is the result of the untiring efforts of the President and Dr. Wm. C. Fisher, as well as Dr. Oren Oliver.

The round table luncheon and discussion was an innovation and seemed to attract considerable attention as well as prove very interesting. The attendance at the round table luncheon was large, there being in all sixteen tables and about fourteen guests assembled at each table. Subsequent to the luncheon each chairman made an informal report of the result of the discussion of the particular topic which had been previously assigned to the table.

The four-day meeting was a new idea and on account of the magnitude of the program, was necessary at the Twenty-Sixth Annual Meeting.

Dr. Walter Ellis, of Buffalo, New York, was elected President and Dr. Leuman M. Waugh, of New York, the new member of the Board of Censors to serve for three years.

The next meeting will go to Buffalo at the request of the incoming president, in regard to details of which ample notice will be given in the future within these pages.

The largest orthodontic clinic ever held was staged the last afternoon. The clinics were held upon a competitive basis. The clinic of the New York district making the best showing was awarded the president's loving cup. There were in all over 90 clinics shown in the afternoon of the last day.

No comment on the success of the Chicago meeting would be at all complete without referring to the tremendous amount of work and detail which was accomplished by the Chicago and Evanston, Illinois, orthodontists in preparation for this meeting. In the words of somebody, sometime, someplace, the meeting was a great success.

The British Society for the Study of Orthodontics

Officers 1927

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Meetings 1927

Jan. 17th.—Short Communication: "The Story of a Failure." Mr. W. A. Bulleid.
Presidential Address: "Problems in Orthodontic Practice."

Feb. 7th.—Report of the Nomenclature Committee: Mr. N. G. Bennett (Chairman).
Paper: "Functional Abnormal Occlusion." Mr. N. G. Bennett.

March 7th.—

May 2nd.—Demonstration Meeting: Mr. C. S. Morris, Mr. Norman Gray and others.

Oct. 3rd.—Short Communications: "Rotation of Molars." Mr. Sheldon Friel.
"Facial Measurements." Miss K. C. Smythe.
Paper: "Further Investigations Concerning Muscles and their Relation to the Growth of the Jaws." Mr. Sheldon Friel.

Nov. 7th.—Short Communication: "The History of a Class 3 Case." Mr. C. S. Morris.
Paper: Title to be announced later. Mr. A. C. Lockett.

Dec. 5th.—Annual General Meeting: Short Communications: Mr. Lewin Payne. Mr. Harold Chapman.
Paper:

The meetings are held at the rooms of the MEDICAL SOCIETY OF LONDON, 11, Chandos Street, Cavendish Square, W. 1, on the dates mentioned above, at 8 o'clock. Short Communications are taken at each Meeting.

Notes of Interest

Dr. H. C. Pollock, of St. Louis, has announced a private Tutoring School of Orthodontia conducted at 4482 Washington Avenue, St. Louis.

Dr. R. Anema, practice limited to orthodontia, formerly 172, Boulevard Haussmann, begs to announce his change of Address to 18, Rue Marbeuf (Champs Elysées) Paris VIII^{e}.

Dr. Alfred Paul Rogers, 520 Beacon Street, Boston, announces the association of Dr. William J. Speers, formerly of Fall River, Massachusetts.

Dr. Donald S. Sterrett announces the removal of his office on May 1, 1927, to 813 Sassafras Street, Erie, Pa. Practice limited to orthodontia.

Dr. G. F. Hanna announces the removal of his offices from the Stroh Building to the Boulevard Temple Building, corner West Grand Blvd. and Twelfth St., Detroit, Mich.